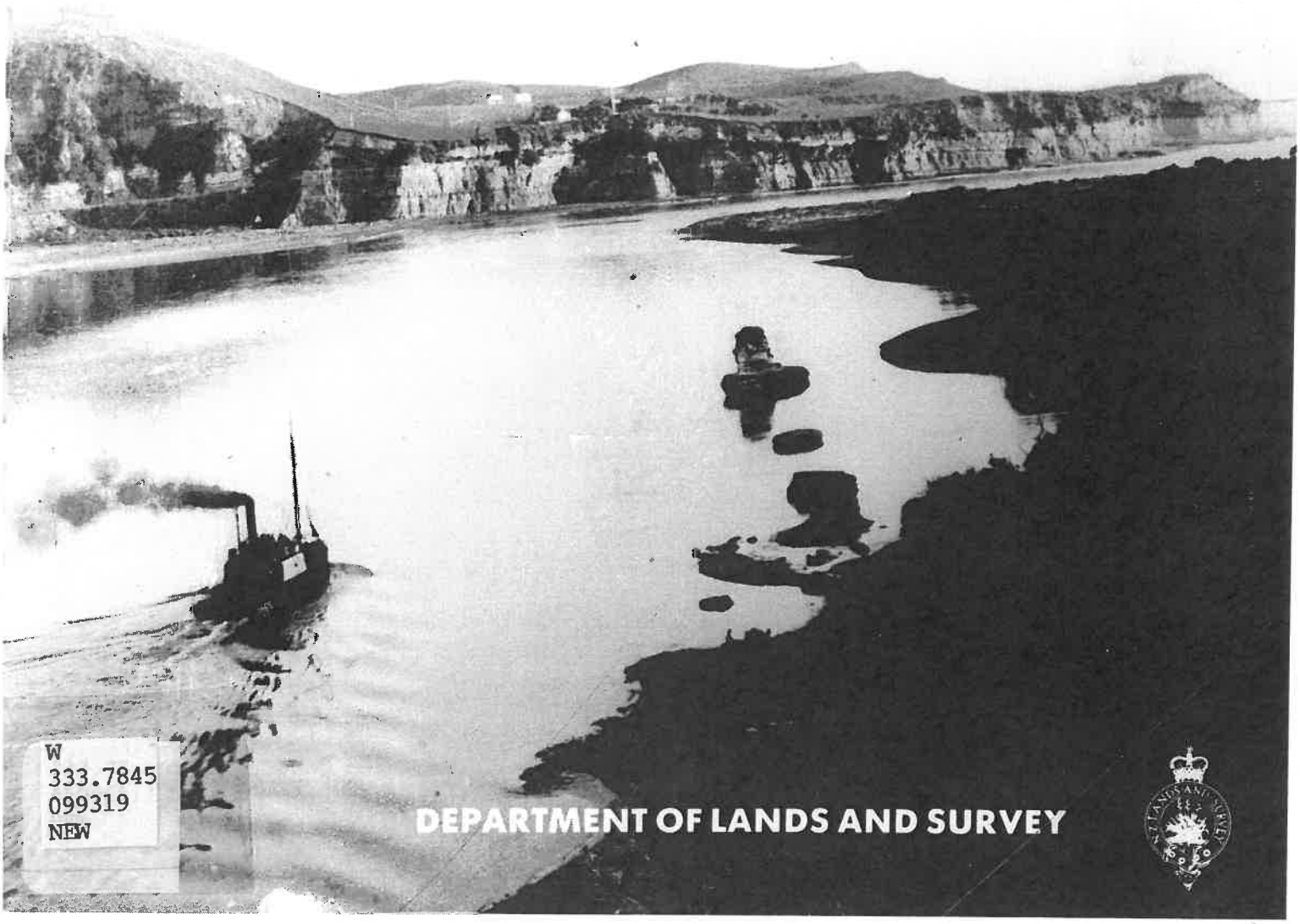
MOKAU RIVER RESOURCE INVENTORY



DEPARTMENT OF LANDS AND SURVEY

MOKAU RIVER RESOURCE INVENTORY

Prepared by

Dept of Lands & Survey
New Plymouth

Dept of Lands & Survey
Hamilton

Published by
Dept of Lands & Survey
PO Box 43
New Plymouth
April 86

CONTENTS

PREFACE

Interest in the Mokau River area has grown dramatically in the past few years. Whitebaiting and hunting have always been popular, but to these recreational activities can now be added canoeing, jetboating and general scenic appreciation. Of potentially greater significance is the interest shown in mining the Mokau coalfield and possibly constructing an associated coal-fired power station on the banks of the Mokau River.

The Mokau River is the boundary between two Land Districts, Taranaki and South Auckland, with both Hamilton and New Plymouth offices sharing the administration of departmental land holdings.

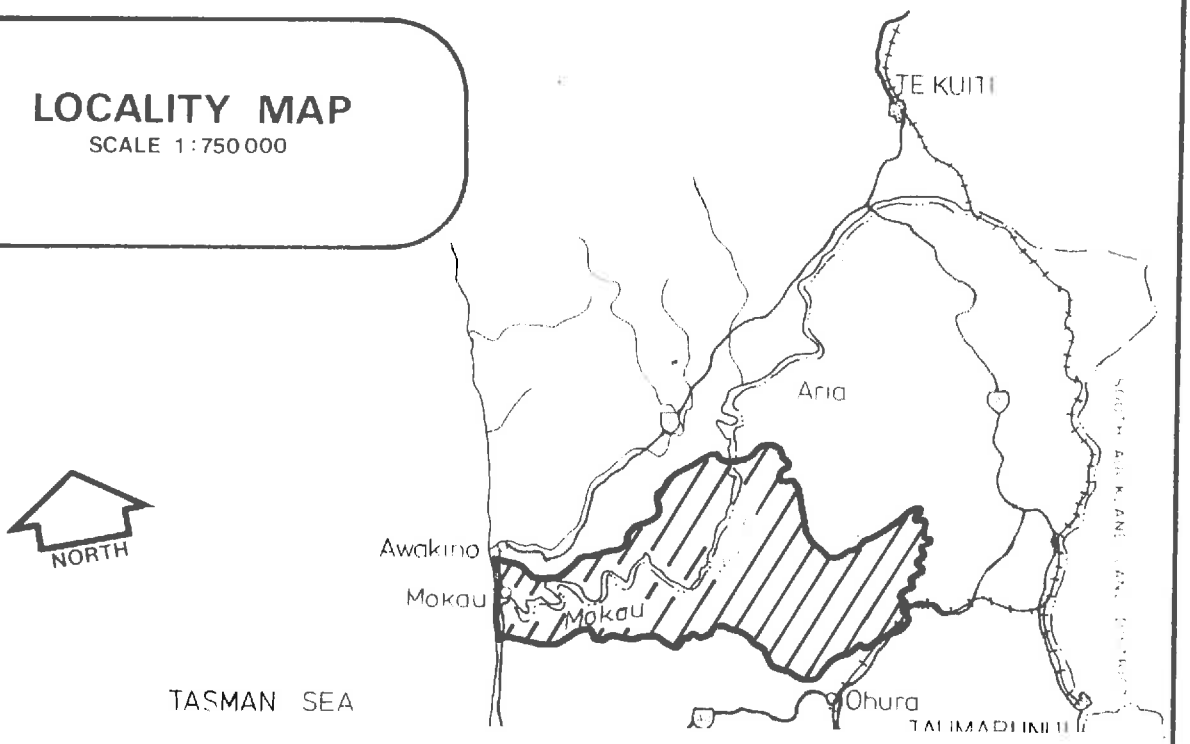
The Department of Lands and Survey has extensive land holdings along the Mokau River, in the form of both scenic reserves and blocks of farm land being developed for settlement. The Department has to be able to manage these lands in the best possible manner, along with being able to develop responses to the new pressures arising in the area. However, the study area generally is a little understood part of New Zealand which has remained largely out of the public eye until recently, and readily available information is sparse.

This report seeks to improve upon the limited understanding of the area held up to now by the Department and, it is suspected, a number of other individuals and organisations with an actual or potential interest in the river and its surroundings. It draws together the threads of published and unpublished reports and information to present a basic assessment of the resources within the area. Little additional field research has been undertaken; the report is more a compendium of information known at this time and where gaps in knowledge exist these have been identified in the text.

Due to limited time available to prepare this report, there is always the possibility that some sources of information were missed, or glossed over at a more rudimentary level than they deserved. Should this be the case the Department would welcome such omissions being drawn to its attention, as it is only by having all available information that the best land management decisions can be made.

LOCALITY MAP

SCALE 1:750 000



PLEASE USE FOIL/TRACING PROVIDED

TO PHOTOCOPY

THIS

NEW

MAP.

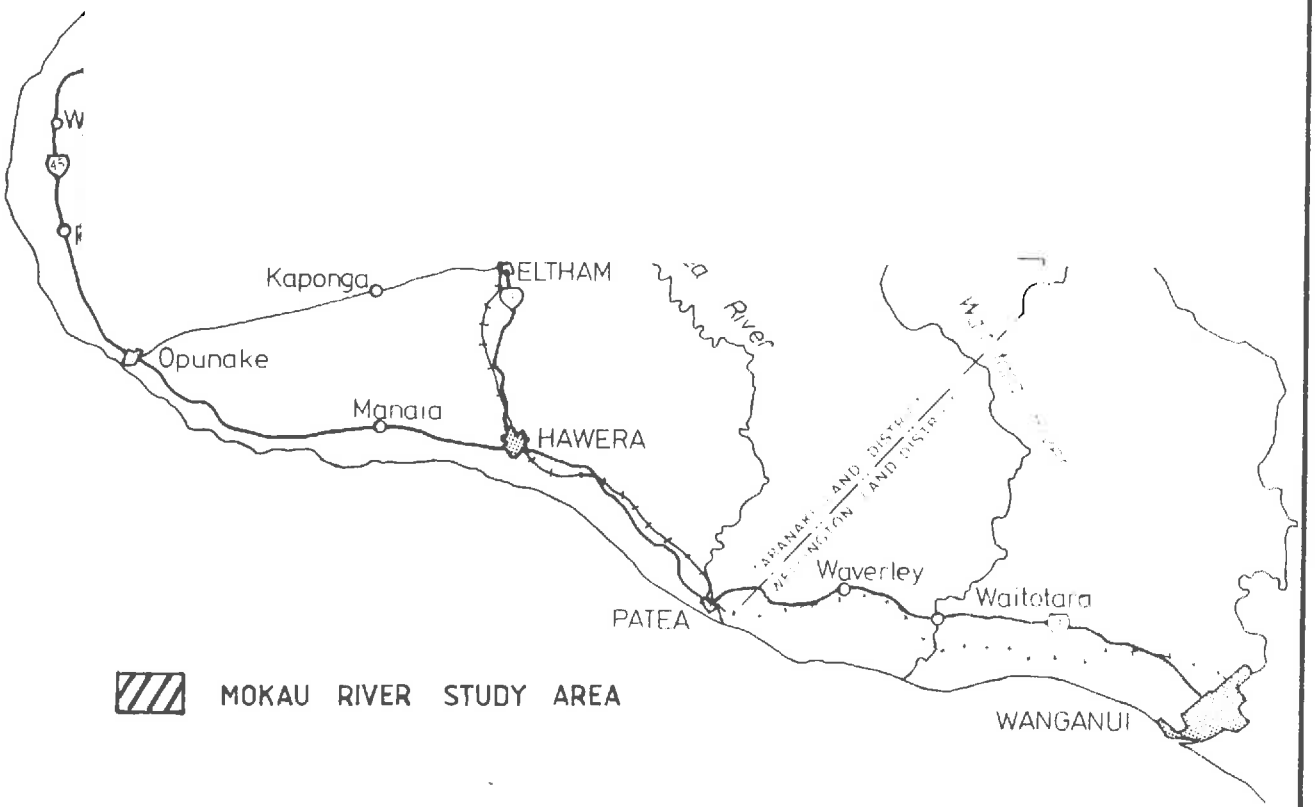


Fig 1

STUDY AREA

While the focus of this report has been the Mokau River and its immediate surroundings, the outer boundaries of the study area have been deliberately left blurred. In general the area covered is the Mokau River Valley from Parahekea Station and Te Matai Station downstream to the coast. However, to adhere to these boundaries totally would be inappropriate as it would preclude any description of the wider ecological significance of the vegetation, any discussion of the Mokau Coalfield as a whole and the full understanding of water quality and quantity due to upstream effects both natural and man-induced. Thus for such issues a wider study area was adopted in order to allow the focal area to be placed in true context and perspective.

ACKNOWLEDGEMENTS

A number of agencies, Government Departments and private individuals have spared the time to tell what they know about the area covered in this study. To mention anyone in particular would be to do an injustice to those not mentioned. The contributions of everyone who gave of their knowledge is greatly appreciated.

This report has been prepared by J Arand, H Clay and M Gibson under the editorial guidance of D Alexander, M Gibson, J Clay, E Meldrum, J Peacock, A McIlroy, Department of Lands and Survey, New Plymouth, and R McQuoid, W Sander, Department of Lands and Survey, Hamilton.

CLIMATE

Introduction

Given the lack of recording stations in the study area a very general outline of the climate of the Mokau region can be obtained by considering the impacts of terrain on the prevailing westerly winds, anticyclones and depressions (that is, the large-scale weather patterns that affect New Zealand).

From the coast at Mokau township up the Mokau River valley and from the valley floors to the hill country ridges, differences in the general weather pattern are to be expected.

Owing to the geographical extent and associated topographical variations it is not possible to characterise the climate of the study area as a whole. In addition, it would be unwarranted to present detailed analysis of the only existing rainfall data at Awakino and Mohakatino given the limited aerial extent and coastal characteristics of these stations.

Climatic Elements

Rainfall

The regional rainfall pattern of the study area is shown in Figure 3 (ref page 2). Increasing annual rainfall up the Mokau River valley from about 1616mm at Awakino and Mohakatino to an estimated 2300mm per annum in the mid reaches of the river, slowly declines to about 1600mm at Pio Pio and even less further east.

This clearly illustrates the effect of topography whereby the western hill country of the study area intercepts moisture laden westerly winds and consequently gets higher rainfall than the eastern equivalent (the Hauhungaroa Range). Summer droughts are a common feature of the weather at Mohakatino Station.

With the relatively high rainfall in the area and the steep and erosion prone banks of parts of the Mokau River Catchment, the river carries a high suspended solids content and historically it has been shown to be subject to relatively frequent and severe flooding and debris accumulation.

Wind

The very exposed aspect of the coast to westerly winds is clearly shown by stunted tainui and karaka plants. In the hill country valleys it is relatively sheltered, but under certain conditions the relief will have a tendency to significantly alter wind patterns resulting in local patterns of wind intensity and direction often quite different from the overall national or regional patterns. On the hill country ridges, prolonged daytime breezes can be expected.

Pronounced night-time cooling of the land in the upper reaches of the Mokau River in the study area would, under some circumstances, create a downstream wind. In general, however, night-times would be still.

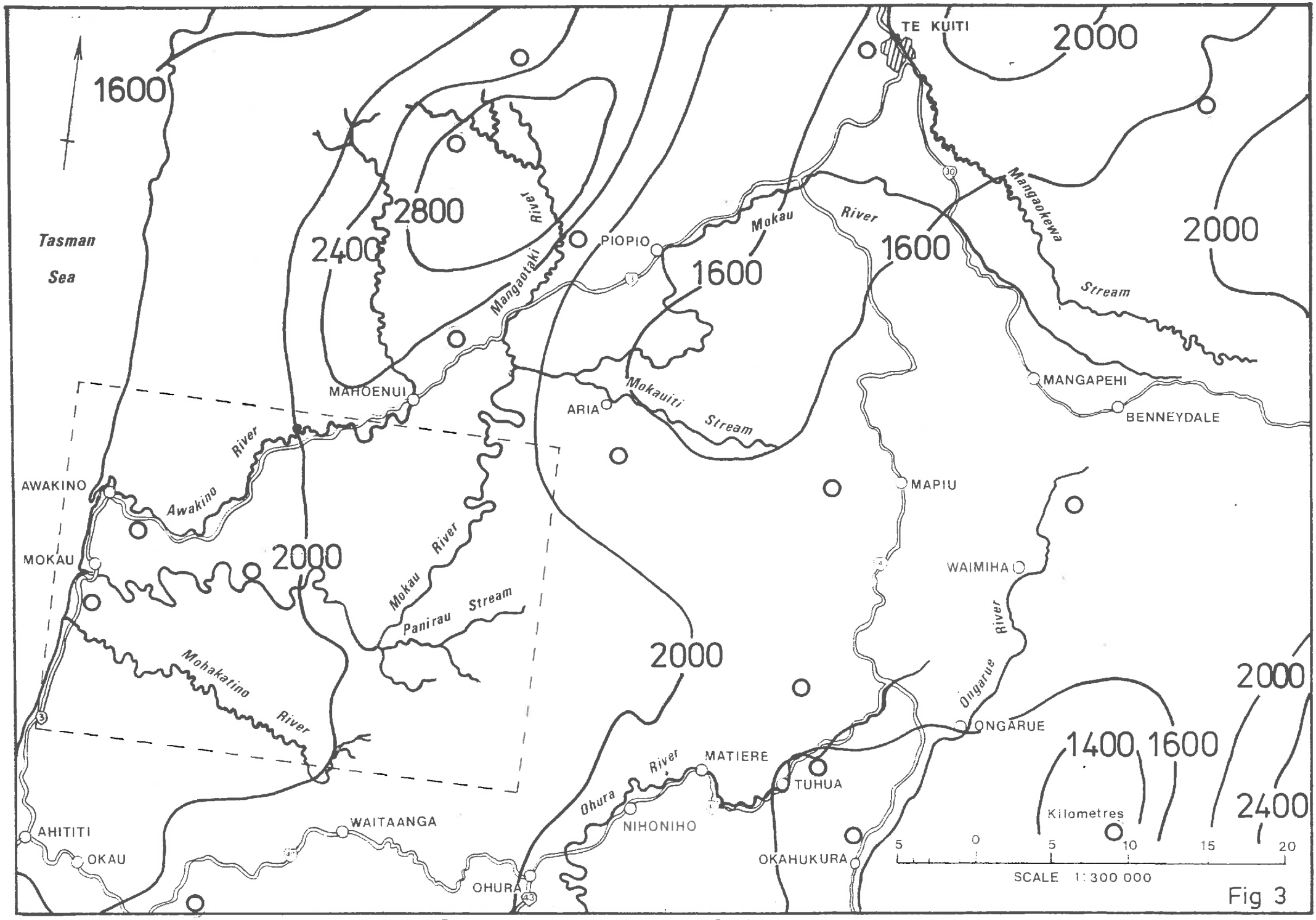


Figure 3 : Regional Rainfall Pattern of Study Area.
○ Station used for drawing Isohyets

Temperature

Because of the sheltering effect of the relief, average inland daytime annual temperatures of the study area would be warmer than the coastal average annual temperature which is 14.2 degrees Celsius at Mohakatino.

Night-time temperatures inland away from the coast would be cooler than on the coast, due to the more rapid cooling of land isolated from the temperature moderating influence of the sea.

Fog and Frosts

Fog may occur in the valleys for two reasons. First, low level cloud base and second, the combination of rapid local cooling and little air movement in the valleys which forms fog if air is cooled to the dew point. Such fogs occur more regularly during winter in the study area.

Sea fogs do occur on the coast but not as regularly as valley fogs.

Descending cold air often causes severe frosts to form in sheltered valley floors during winter.

Thunderstorms, Hail and Snow

Thunderstorms, snow and hail are a rare occurrence in the study area. Such events occur further inland, in the area around the Mokau Catchment headwaters.

Hill country elevations of the study area are not sufficient to maintain a consistent snow cover. Extreme conditions may, however, lead to short-period dustings on the hill country ridges.

Conclusion

Extending from the coast to inland Pio Pio, the study area shows marked climatic variation in changing from a predominantly exposed area with a low (1616mm) rainfall, to a sheltered yet, in the main wetter (2300mm) region, with greater temperature variations which experience many more fogs and frosts. Further east at Pio Pio rainfall reduces to about 1600mm.

In the hill country, climatic variation is also shown as an elevation affect from sheltered, frost frequented valley floors to exposed and occasionally snow dusted ridge and plateau tops.

As a consequence of this climatic variation inland from the coast, vegetation also changes from karaka and kohekohe to rimu, tawa, miro, Hall's totara and rata up the valley.

In summary, it can be predicted that the weather of the Mokau region shows how the national weather pattern is modified by both coastal exposure and the inland terrain. However, consideration must be given to the fact that predictions - generalisations made in this section, lack any substantial data base. Full climatic data are restricted to those recorded at the coast at Mohakatino (see Figure 2). There are no recent records available of rainfall or any other climatic factors within the study area, except on the coast at Mohakatino.

Before any major development occurs in the study area, accurate weather data, especially rainfall, must be obtained over as long a period as possible.

REFERENCE INFORMATION

1. Town and Country Planning Division, Ministry of Works, 1973:
National Resources Survey Part VIII Waikato, Coromandel, King Country Region

2. Thompson, C S, 1981:
The Climate and Weather of the Taranaki Region, New Zealand Meteorological Service Miscellaneous Publication 115(a)

3. Prepared for Mines Division, Ministry of Energy by Applied Geology Associates, 1984:
New Zealand Coal Resources Survey, Mokau Coalfield, Existing Environmental Data Survey

4. Kevin Alder (Pers. comm)
New Zealand Meteorological Service, New Plymouth

Mokau River Study Area

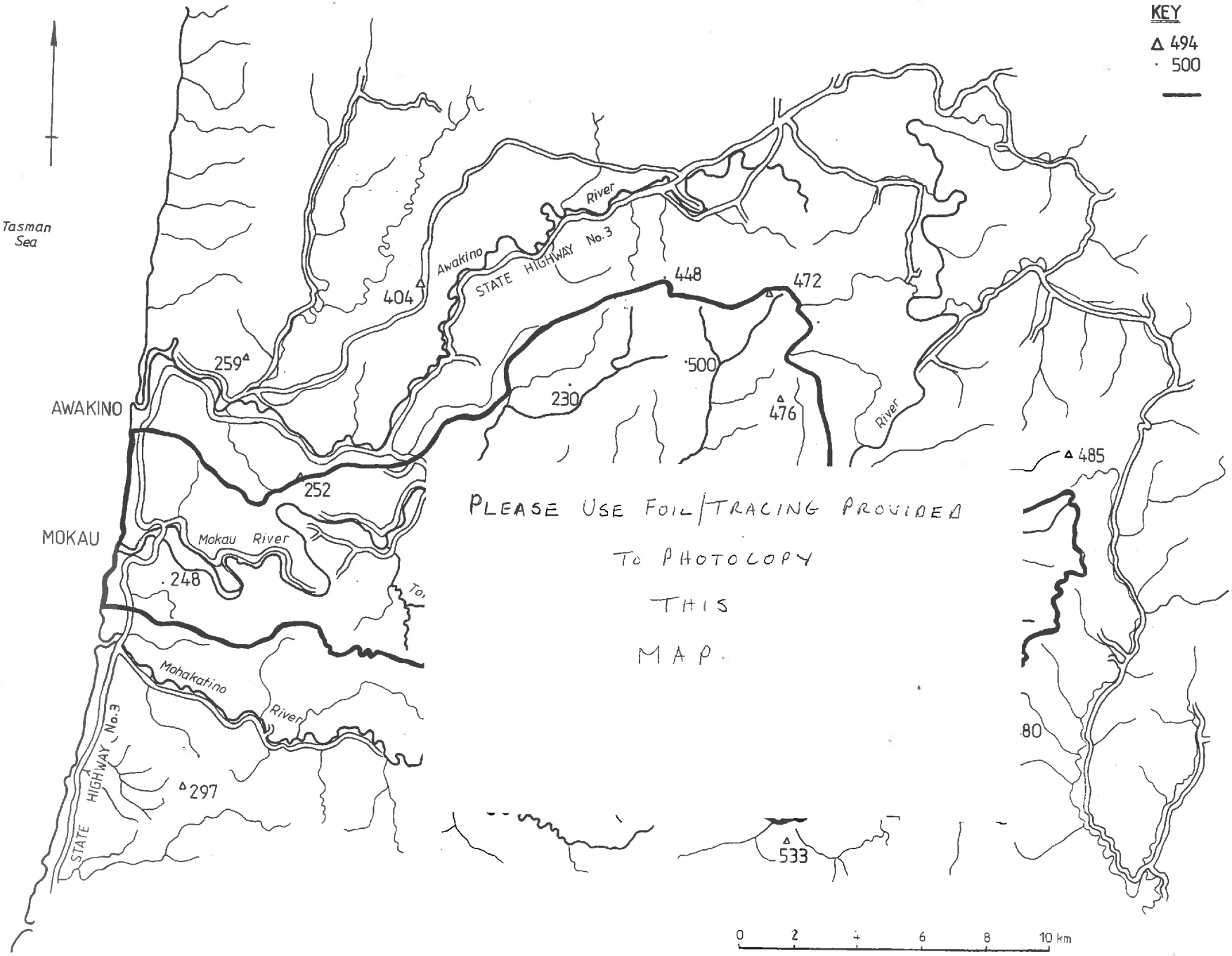


Fig. 2

GEOLOGY AND GEOMORPHOLOGY

Introduction

In this section the geology and geomorphology are described. Also described are the location, boundaries, geology and resources of the Mokau Coalfield.

In the past, the study area has not been studied as a separate entity. However, parts of the area have been examined and described closely in the course of exploration work related to the coalfield, whilst at a small scale the New Zealand Geological Surveys 1:250000 geological map of Taranaki has provided a good basic regional geological description to work from.

Structure

The study area is in the north-western part of the North Wanganui Basin. This part of the basin is bounded to the west by the Taranaki-Whareorino Faults and to the east by the Aria-Waipa Faults. Between these two fault systems, which have seen both horizontal and vertical movement, the block of Mesozoic basement rocks has been squeezed upwards, and is known as the Patea-Tongaporutu High. This upward movement has taken place periodically throughout the time of Tertiary sedimentation. The uplift accounts for the hill country of eastern Taranaki, whose generally level summit surface, now much eroded, is a peneplain created under marine conditions.

With the great pressures induced by the uplift and other earth movement, smaller faults and fault tracers are found through the area.

Stratigraphy and Geological History

The surface geology of the study area is shown in Figure 4. Owing to the small scale used in mapping (1:250000) details such as exposures of underlying rock groups in stream and river gorges or the limestone bluffs are not able to be shown. More detailed large scale geological mapping is only available for the coalfield and is described in this section.

There are basically three main rock groups in the study area, these being (a) Mesozoic (b) Tertiary and (c) Recent rock.

(a) The oldest rocks in the Mokau area are the Mesozoic or pre Tertiary agglomerates, grits and claystones which underlie all the surface rocks in the area but outcrop in the Awakino gorge, north of the study area. The various types identified among the Tertiary rocks are given in Table 1 (ref pages 15 & 16).

(b) Sedimentation on the surface of the Mesozoic basement rocks, to form the first of the Tertiary rock sequences, began in this region some 40-45 million years ago with a series of coal measures and clays, the Waikato Coal Measures and Whaingaroa Siltstone, in some low lying areas. Open sea shelf conditions then resulted in the formation of the Te Kuiti Limestone from the leaching of calcium compounds from the landmass and from skeletal fragments of organisms. None of these rocks are exposed on the surface in the study area, though they are found in the Mahoenui-Totoro area upstream. In the Mahoenui period, about 25 million years ago, depositional conditions then changed to deep shelf and slope conditions as ancestral New Zealand was virtually submerged by the sea. The bulk of the sediments are mudstones with a few thin beds of limestone along the western rim of the basin. In

the study area because of downcutting by the Mokau River into the tertiary beds, these rocks are exposed from just downstream of Panirau Island to approximately Mangatoi Stream.

Conformably overlying the typically fine-grained Mahoenui Group is a predominantly sandstone group, the Mokau. The increase in coarseness is associated with local uplift characteristics of restless early Miocene activity (about 20 million years ago). Much of the surface geology and riverbank exposures in the study area are of Mokau Group sediments. The upper Mokau Sandstone Formation is usually recognisable in much of the study area as it forms many of the bluffs or steep hillsides. However, the same formation forms plateau surfaces in the northern part of the study area.

Swampy river deltas in the North Taranaki area laid down deposits that were later to become the Mokau coals. The Ohura Fault was active at this time (mid Miocene) and consequently uplifted portions of Mahoenui rocks to the east of the study area supplied sand and mud to the western lagoons (the high sulphur content of the Mokau coals is related to these brackish and saline conditions). More detail about the Maryville coal measures, which are the basis of the Mokau coalfield, is provided later in this section.

In Mohakatino times (10-15 million years ago) the sea transgressed far to the east and volcanicity broke out at sites to the east of the present coast leaving tuffs covering extended areas to the south and east. The Mohakatino Group is very well exposed in the study area as the highest north-east to south-west tending ridge 'backbone' on the north side of the Mokau River cutting across Mangatoi Station. Relatively high knobs and ridges throughout the rest of the study area will generally be composed of Mohakatino Group sediments. Since the deposition of the Tertiary rocks the sediments have been subject to marine erosion and deposition as they were raised above sea level. Erosion created the peneplain surface characteristic of the whole of eastern Taranaki. Following this there was a period of major uplift activity.

(c) In geologically recent times, volcanic ashes and tuffs from the Taupo and Egmont eruptions have drifted on to the eroded surface of the Tertiary rocks. In the study area, any such deposits have been on such a small scale as to be discounted in any regional geology description. If they remain today it is only in local patches on flat land.

The youngest geological components are marine sands on the coastal terraces, and alluvium on river cut inland terraces and present day river flats.

The above description has not used the term 'papa'. While papa is not generally recognised by geologists, soil scientists or engineers, it is often used by lay people to describe soft, and often unstable sandstones, siltstones and mudstones. Such rocks are usually of a uniform battleship-grey or blue grey colour and commonly weather to a yellow colour. People who live in the study area use the word 'papa' to describe blue-grey, and sometimes slightly calcareous, mudstones which, while initially very stable when cut into (as in road cuttings) tend to weather rapidly by flaking and falling. Papa rocks in the study area would, generally, be members of the Mohakatino Group of sediments.

Geomorphology

The land forms of the study area can be divided into two principle physiographic units:

(a) The physiographic unit forming the bulk of the study area consists of the fluvially dissected inland hill country. This hill country consists of highly dissected Upper Tertiary marine mudstones, sandstones and mino limestones that were uplifted from the sea during Quarternary times and are now tilted to the south. Valleys are narrow and steeply sloping with narrow and sharp ridges separating them. Few recent deposits have been preserved on ridge crests, reflecting active fluvial incision and erosion.

The topography varies considerably with broad expanses of gently undulating to easy rolling terraces bordering the Mokau River and some tributaries; similar gentle contours are encountered at several plateau-type areas along the main ridges. Many ridges are, however, razorbacks with slopes often dipping away at 30-35%. Cliffs and bluffs also occur throughout the inland hill country. Such features have been formed by both coastal and fluvial (river) erosion as well as recent faulting.

Natural drainage of the study area is by the Mokau River and tributaries. The river is a good example of an entrenched meandering river which has cut deeply into the original valley floor - occasionally even through to Mesozoic rocks at Totoro Gorge. Sometimes the river is bordered by narrow flats and terraces. This incised, dendritic drainage pattern resulting in the river and streams becoming entrenched in gorges has, in part, caused the access problems of today.

(b) A narrow coastal strip of uplifted marine terrace, comprising coastal sand country, the river flats and low terraces formed by successive high sea-levels cutting near planar surfaces across relatively soft late Cenozoic sediments. The most prominent raised terrace is about 30 metres above sea level and, except for the gap at the Whitecliffs, extends from north of Awakino to the Taranaki lowlands. Upon each withdrawal of the sea, a relatively thin veneer of marine sands and gravels, sometimes containing marine fossil assemblages, was deposited immediately above each wave cut platform surface. The sea-front terrace of the study area has a surface of well bedded sands containing many volcanic rock minerals and rounded pebbles, and dunes known as the Rapanui Formation. Between each high sea-level episode the land was slowly uplifted carrying each marine bench above a level where it could be removed by a later marine planation episode. The result was the creation of an extensive sequence of marine terraces, each one being progressively higher and older moving inland.

Below the coastal marine terrace is a sand beach about 100 metres in width (but often only exposed at low tide) fringing the shore line. The widest beaches occur north of the Mokau River because of material brought down by the river and distributed by the prevailing northerly beach drift. Where the sand beach is minimal or absent, cliffs formed by a combination of tectonic uplift and wave cutting into the marine strata are highest, as at the Whitecliffs. Caves, tunnels, stacks and outlying rocks, wholly or partly submerged, also occur.

Each river enters the sea on the south side of its narrow estuary where it flows hard against a bluff of hard rock. North shore drift tends to shift river mouths to the north where silt is dropped when the stream current loses force. Faulting probably also plays a controlling role on a rivermouth estuary construction.

A small grass covered flat 4-5 metres above the sea at Mokau township fringes an old seacliff with caves and outlying stacks that have been comparatively recently formed during a pause in uplifts.

Caves formed by the sea are found north and south of the Mokau River Mouth, while running fresh water has produced exceedingly numerous caves in the limestone rocks north of the study area where sinkholes are distinctive topographic features marking underground streams (many small tributaries of the Mokau River have subterranean courses).

Other geological features include concretionary boulders derived from the Mohakatino Group sandstone beds and fossil tree trunks in Holocene deposits overlying the Rapanui Formation. Both these features are to be seen near the mouth of the Waihi Stream. While not unique, the occurrence of these 'boulders' and fossil tree trunks together in the same locality is relatively unusual and warrants mention.

One part of the geology deserves particular consideration because of the current interest being shown. This is the Maryville Coal Measures, a sequence of coal seams underlain by Lower Mokau Sandstones, and overlain by Upper Mokau Sandstones. As previously discussed, these measures were laid down in swampy deltaic conditions. The boundaries of the delta have become somewhat obscured by erosion, but the pattern of thinning of the coal seams gives some indications. In general the boundaries can be said to be the Awakino and Mokau River (north of Panirau Island) to the north and east respectively, and the Awakau Road to the west. The southern boundary is undefined, though the Coal Measures are known to continue south of the Mokau River. The Measures dip gently to the south-west and outcrop on the surface where rivers and streams have cut down into the Tertiary sediments.

The Maryville Coal Measures typically contain five coal seams generally varying in thickness between 1.0 metres and 2.6 metres. The seams are separated by carbonaceous sandstones between 5 metres and 15 metres thick.

The stratigraphic setting of the Maryville Coal Measures is very different from that of the more widely known Waikato Coal Measures. Deposition of the Maryville Coal Measures under considerable marine influence is shown by a high montmorillinite clay content, common pyrite, high sulphur content in the coal, local concentrations of vivansite and the presence of marine fossils. Coal deposition took place and was followed by the accumulation of thick, near-shore, marine sediments providing an extremely uniform base for swamp, and consequently coal development as well as a satisfactory roof for potential underground workings. The Maryville Coal Measures can be divided into three parts: upper and lower shaley units separated by a bed of sandstone.

On the basis of geographical and geological grounds, the Coalfield is broken into three main subdivisions and smaller sections. The geological structure and implications for mining for each of the three main subdivisions is very briefly summarised below.

1. Northwest (Mangawaakino)

The northwestern subdivision of the Coalfield covers some 50 square kilometres and contains coal measures with a regional dip of 2.5-5.5 degrees to the southwest. These measures contain five coal seams which appear to be generally consistent. They are overlain by Mohakatino and Upper Mokau sandstones ranging generally from 50 to 200 metres in thickness above the third seam. The reserves are bounded by thinning of the seams to the east, south and west and by outcrop elsewhere. While no faults have been identified as yet, a major fault in a westerly direction and additional smaller faults are expected.

Because of the considerable overburden thickness of the Upper Mokau Sandstone and the Mohakatino Group, any mining would have to be by underground methods.

2. Northeast (Papakauri)

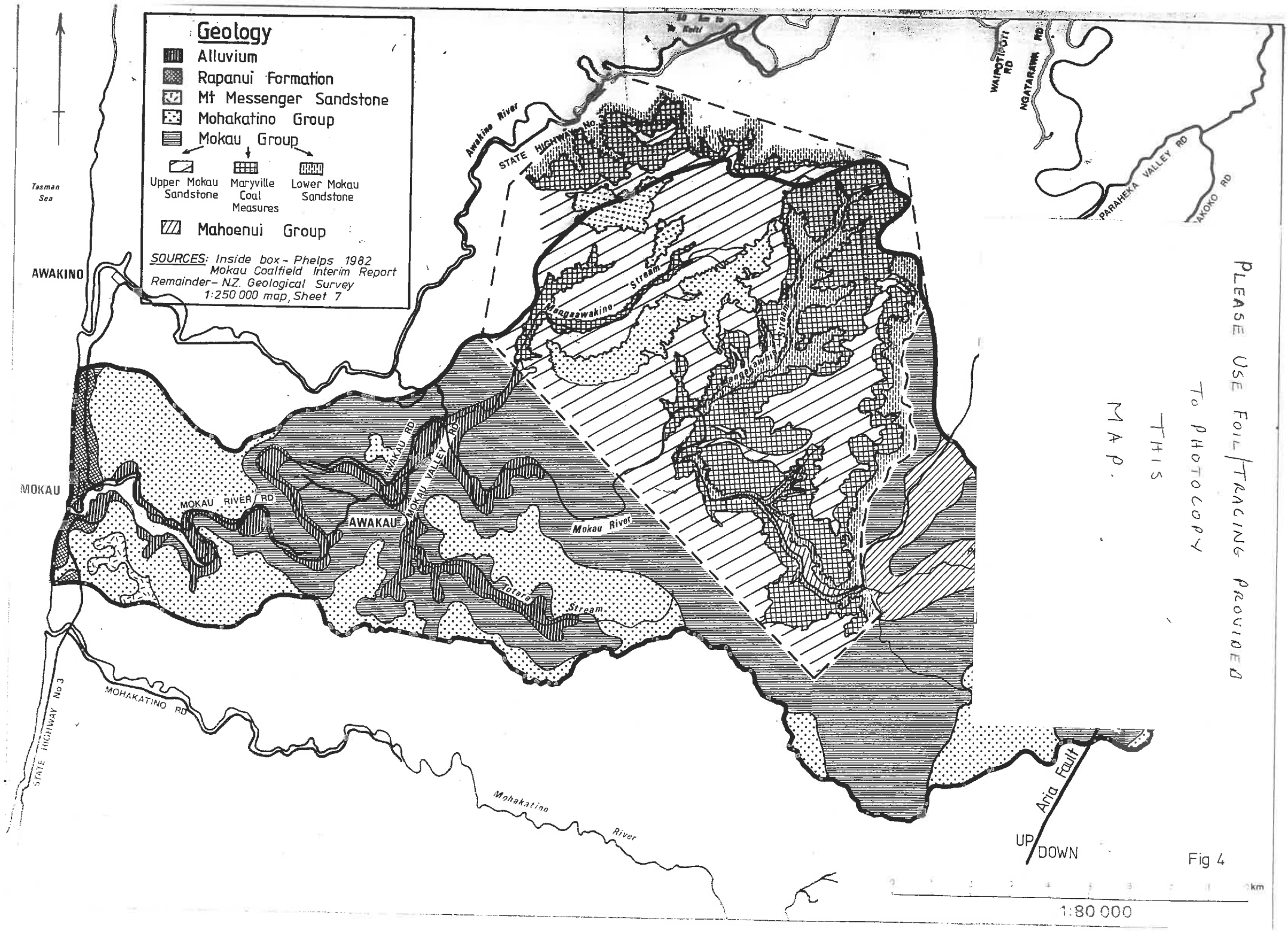
This area is not yet well explored. Generally the seams have thinned and the majority of the coal lies beneath a thick overburden of Upper Mokau Sandstone. In one place this overburden has been eroded away and the potential for opencast mining exists.

3. South (Mangatoi)

The southern subdivision of the Coalfield is the best explored to date because the Upper Mokau Sandstones have been eroded away. There is thus only a relatively thin covering of overburden consisting of sandstones and unconsolidated silts, sands and clays (known as the Tauranga Group), which would allow for opencast mining. The coal measures dip to the southwest at a 4 degree gradient, and four seams have been identified (the fifth top seam has been largely eroded away during the formation of the terraces) ranging in thickness from 0.5 metres to 2.5 metres.

Conclusion

The geology of the study area largely comprises Tertiary sandstones, siltstones, mudstones, limestones, and coal measures over a Mesozoic basement strata. Quarternary volcanic ashes and fluviate/marine deposits complete the stratigraphic record. The extent of each lithographics group is related to past sea-level and earth crustal movements associated with the north Wanganui Basin. Such movements, in conjunction with erosion by running water have been the dominant factors in the formation of the present day landscape comprising the deeply dissected Mokau River and tributaries and a series of uplifted marine terraces.



PLEASE USE FOIL/TRACING PROVIDED TO PHOTOCOPY THIS MAP.

Fig 4

REFERENCE INFORMATION

1. Henderson, J and Ongley, M, 1923:
Geology of the Mokau Subdivision,
New Zealand Geological Survey Bulletin No 24

2. Fried, T R, 1979:
The Stratigraphic Trap Potential of the Mokau Sediments
M Phil. Thesis, University of Auckland

3. Langworth and McKenzie Pty Ltd, December 1982:
New Zealand Coal Resources Survey - Interim Mining Feasibility Assessment - Mokau Coalfield

4. Nelson, C S and Hume, T M, 1977:
Relative intensity of tectonic events revealed by the Tertiary sedimentary record in the Martin Wanganui Basin and adjacent areas, New Zealand.
Journal of Geology and Geophysics 20, (2) : 369-92

5. New Zealand Geological Survey, 1967:
Geological Map of New Zealand - Sheet 7 - Taranaki

6. Phelps, D J and Co Ltd, August 1982:
New Zealand Coal Resources Survey - Mokau Coalfield - Interim Report of Exploration

7. Soons, J M and Selby, M J, 1982:
New Zealand Landforms

8. Stevens, A, 1980:
New Zealand Adrift

9. Suggate, R P (ed), 1978:
The Geology of New Zealand - Volume II

10. Dianne Toole (pers comm)

SOILS

Introduction

Soils are a product of the combination of an area's parent material, vegetation, climate, topography, human activities and time. In this section, this 'factors-approach' of soil formation is used to describe the soils of the study area, which are many and varied as a result of the variety of expressions of the factors named above.

A reconnaissance survey of the soils of the North Island was carried out in the 1950's. This piece of work was also used for the New Zealand Land Resource Inventory Worksheets. While these two references are all that is available about the soils of the study area, they are sufficient for the level of detail required herein.

Soil Pattern of the Study Area

(i) Soil Profiles and Formation

Details outlining parent material, native vegetation, topography, soil profile, natural fertility, soil erosion and land use are shown in Table 1 (ref pages 15 & 16). The soil distribution in the study area is shown in Figure 5 (ref page 17). In the study area the factor of parent material, often in conjunction with the factor of topography, and especially the component of slope, dominates in the formation of most of the soils encountered.

The influence of topography is related to the two associated processes of past tectonic uplift and active erosion. Deep fluvial dissection of uplifted blocks has created in parts of the Study Area very steep sided valleys and ridges. Ash deposited on these slopes is easily washed away because of fluvial and gravity influences. Any soils which developed on the steeper slopes are, therefore, formed upon either sandstone (Mokau sandy loam) or banded mudstone-sandstone (Mahoenui silt loam). The soils formed on sedimentary rocks have formed on different parent materials but have broadly similar characteristics. They have a grey-brown loamy profile overlying weathered or unweathered parent material; their topsoils are generally moderately deep and there is a close relationship between texture of the soils and the parent rocks.

On less steep surfaces and plateaux the erosion processes do not operate so significantly and soils have formed on ash deposits (Mapiu and Aria silt loams). Soils associated with volcanic ash have characteristic properties that are dissimilar to those of other parent material groups. The volcanic ash soils are typically friable, dark coloured and strongly structured with regional differences between them related mainly to climate and to the origin and age of the ash.

Intergrades between the sandstone-mudstone and ash soils also occur (Te Pari sand clay loam and silt loam).

Eroded ash and sandstone debris usually reaches the valley streams or the river and, where deposited, forms the parent material for the recent alluvial soils (Kairanga silt and clay loams) of the river flats and terraces. Coastal and organic parent material influences associated with differences in drainage properties (Ahuriri silt loam and Whangamarino loamy peat respectively) have complicated the basic alluvial soil pattern.

TABLE 1 : SOILS OF THE STUDY AREA - ENVIRONMENT AND LAND USE

Map Symbol	SOIL GROUPS (SOIL UNITS)							
	Parent Material	Topography	Native Vegetation	Rainfall p.a. (mm)	Profile	Fertility	Erosion	Use
	Steepland Yellow Brown Earths (Mahoenui silt loam, Mokau sandy loam, Mohakatino sandy loam)							
	Banded mudstones and sandstones	Steep and very steep with bluffs	Broadleaf-podocarp forest	1270-2200	Grey-brown silt loam on mudstone. Shallow grey and brown sandy loam and clay loam on claystone. Fragments of parent material throughout.	Low (on sandstones) High (on mudstones)	Slips which heal readily (mudstone) slowly (sandstone)	1,2,3, much in forest or scrub
	Yellow Brown Loams (Aria silt loam, Mapiu silt loam, New Plymouth black loam, New Plymouth brown loam)							
	Egmont, Stratford and Mairoa ash and mud-flow debris over sandstone	Hummocky to moderately steep	Broadleaf-podocarp and mixed forests	1500-2500	Brown to black silt loam on a compact yellow to brown silt loam	Medium	-	2,3,5,6
	Central Yellow Brown Earths (Mangatea clay loam and silt loam, Te Pari sandy clay loam and silt loam)							
	Banded mudstone and sandstone some with Mairoa ash	Rolling to moderately steep	Broadleaf-podocarp forest	1140-2030	Dark brown compact clay loam (or grey-brown silt loam if Mairoa ash present) on light yellow brown compact clay or clay loam	Low to high	Slips which heal readily	2,3,4,5

Table 1 Continued

	Recent Soils from Alluvium (Kairanga clay loam and silt loam)							
	Alluvium	Flat	Kahikatea, rata, matai and flax	700-2030	Grey silt loam on clay loam mottled grey or brown	High to very high	Stream flooding and scouring	5,6
	Organic, and Saline Soils (Whangamomona loamy peat and Ahuriri silt loam and clay)							
	Peat and some alluvium, and estuarine silt and mud	Flat	Rushes and Manuka and salt tolerant plants	700-1270	Dark grey loamy peat on fibrous peat with water table on surface, Deep grey to bluish grey silt loam and clay	Low, and high when salt removed	-	Unused, 5, 5a
	Yellow brown Sands (Patea sand, Red hill sandy clay loam, Whananaki sand)							
	Brown and grey dune sands	Flat to easy rolling	Sand-grass, fern and manuka	890-1400	Dark brown or black sand to sandy clay loam on free or compact grey or brown sand, some with manganese nodules	Low to medium	Wind	4,5,6

Source: D.S.I.R., 1954 : General Survey of the Soils of the North Island, New Zealand. Soil Bureau Bulletin (n.s.) 5

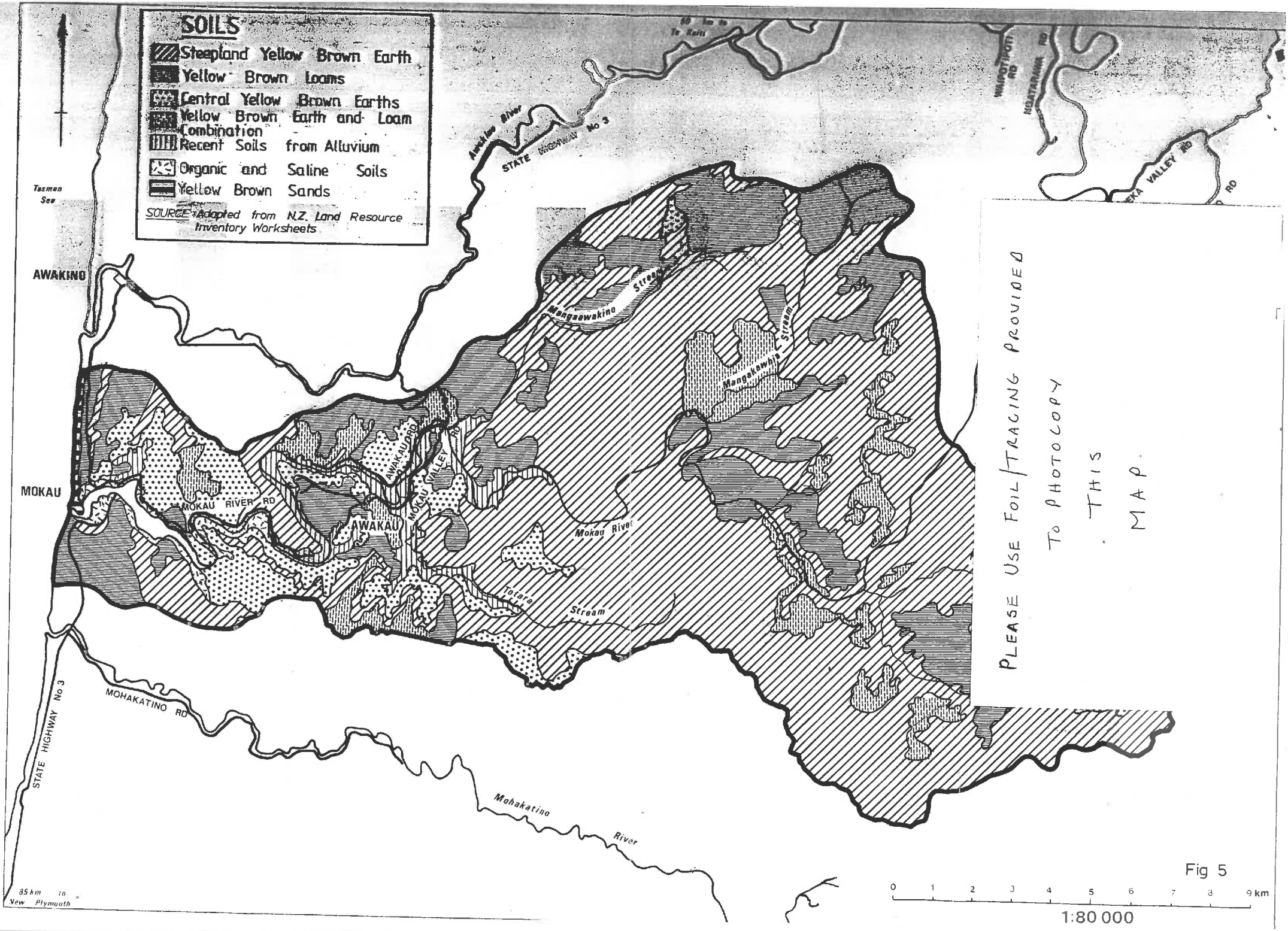

SOILS
Steepland Yellow Brown Earth
Yellow Brown Loams
Central Yellow Brown Earths
Yellow Brown Earth and Loam Combination
Recent Soils from Alluvium
Organic and Saline Soils
Yellow Brown Sands
SOURCE: Adapted from N.Z. Land Resource Inventory Worksheets
Tasman Sea
AWAKINO
MOKAU
STATE HIGHWAY No 3
Awakino River
Mangaowakino Stream
Mangakawhia Stream
MOKAU RIVER RD
AWAKAU
AWAKAUPIKO
MOKAU VALLEY RD
Mokau River
Totara Stream
MOHAKATINO RD
Mohakatino River
35 km to New Plymouth
PLEASE USE FOIL/TRACING PROVIDED TO PHOTOCOPY THIS MAP.
0 1 2 3 4 5 6 7 8 9 km
1:80 000

Fig 5

REFERENCE INFORMATION

1. Department of Scientific and Industrial Research, 1954: General Survey of the Soils of the North Island, New Zealand, Soil Bureau Bulletin (n.s.) 5

2. Department of Scientific and Industrial Research, 1977: Soils of Part Wanganui County, North Island, New Zealand. Soil Bureau Bulletin 40

3. National Water and Soil Conservation Organisation, 1979: New Zealand Land Resource Inventory Worksheets (N91,100), Ministry of Works and Development (Water and Soil Division)

VEGETATION

INTRODUCTION

The Department's interests with regard to vegetation in the study area are primarily in native vegetation. Consequently, this section will not deal with pasture grasses nor other introduced species.

A botanical survey of the Department's scenic reserves bordering the banks of the Mokau has been carried out.

The vegetation pattern on the northern and southern banks is similar. However, the reserves on the northern bank involve a less extensive area and consequently contain a less dense flora. Forests on the northern bank are in a better condition nearer the coast than those on the southern bank.

Because of the diverse range of habitats and the large size of the reserves, there is a very high number (258) of native plant species. The four main native vegetation associations: (i) Karaka-kohekohe-nikau, (ii) Pukatea-kahikatea, (iii) Tawa-karaka, and (iv) hard beech, are described in detail in this section. Other less extensive but ecologically important associations are also mentioned. The Tainui Reserve and a block of native vegetation facing State Highway 3, as yet unreserved, are also described.

Karaka-Kohekohe-Nikau

This semi-coastal forest lies within five kilometres of the coast and contains coastal species such as kohekohe, karaka and puriri on both the northern and southern river banks. Other common canopy species include tawa, kamahi, rewarewa, nikau and mahoe with associates of hinau, pukatea, lancewood, heketara and mangeao. Rewarewa is prominent on the ridges and spurs with Hall's totara, miro, tarekaha and heketara. On the northern bank emergent rimu and rata occur throughout this vegetation type. Ferns (crown fern, hen and chicken fern, *Blechnum filiforme, B lanceolatum*), bush rice grass and hooked sedges constitute the groundcover.

Pukatea-Kahikatea

This vegetation type occurs on the alluvial river flats. The canopy consists predominantly of varying amounts of pukatea and kahikatea. Other canopy species include tawa, kamahi, cabbage tree, karaka, kohekohe, lancewood, pigeonwood, hinau and some emergent rimu and rata.

The most common species in the very variable understorey are wheki, nikau, Smith's tree fern, marble leaf, kamahi, mahoe and the lianes kiekie and supplejack.

Groundcover species include *Carex spp.*, hooked sedge, *Cyperus ustulatus*, bush rice grass, *Blechnum filiforme*, and some adventives (fox gloves, lotus, creeping buttercup).

Tawa

From approximately three kilometres inland tawa forest is the common vegetation type in the gullies and on the slopes with pukatea, kamahi, hinau, lancewood and rewarewa scattered throughout. Karaka is a common associate near the coast. Rimu and rata are emergent over the canopy.

The common understorey species are silver fern, young tawa, kamahi, heketara, mahoe, occasional nikau and pigeonwood with Smith's tree fern in the gully bottoms.

The groundcover is variable, the most frequent species being bush rice grass, crown fern, hooked sedge, *Blechnum filiforme* and climbing rata.

A relatively large area of tawa-karaka forest forms a vegetation transition between the coastal karaka-kohekohe-nikau forest and tawa forest further inland.

Hard Beech

On the ridges and spurs from approximately six kilometres inland, hard beech forms an almost exclusive canopy with scattered tanekaha, Hall's totara, miro and kamahi. There are also local pockets of black beech. The understorey consists of mingimingi, kamahi and mapau while the groundcover is commonly crown fern, kidney fern, filmy fern and hard beech seedlings. The groundcover is, however, generally sparse due to the steep nature of the ridges and to goat browsing.

Other

Other stands of native vegetation not quite as large as the ones previously described include: rewarewa emergent over a canopy of almost pure kanuka; cabbage tree emergent over a canopy of almost pure manuka (on a very swampy flat adjacent to the river); *Cyperus ustulatus - carex spp.* (on a strip along the river bank subject to occasional flooding); *Leptocarpus similis* (tidal river edge community); manuka (regenerating bush after clearing); and kamahi (seral forest). While of limited areal extent the cabbage tree - manuka, *Cyperus ustulatus - carex spp.* and *Leptocarpus similis* botanical associations are ecologically very important.

In addition to the legendary and historical importance attached to them, tainui trees, which are only known at two coastal localities at Mokau are scientifically very important. The species is presently only reserved at one locality, the Tainui Scenic Reserve, which is on the right hand side of the main road about two kilometres north of Mokau.

On the southern bank of the Mokau rivermouth on the steep slopes adjacent to the main road there is a patch of karaka-kohekohe forest and coastal shrubs and herbs. Forest species include titoki, whau, mangeao, akeake, kowhai and lacebark.

Shrubs and herbs include: *Hebe stricta, var. macroura, coriaria arborea, Disphyma australe, Tetragonia trigyna* and *Samolus repens*. Wet banks adjacent to waterfalls in the bush are draped with *Machaerina sinclairii* and flax *(Phormium cookianum)*.

Landslides in the Reserves are at different stages of recolonisation. Very recent slips have scattered weeds such as foxglove, grasses and thistles. Slightly older slips are covered primarily in tree ferns and/or broadleaf species such as mahoe, rewarewa, five-finger, kamahi and heketara.

The bluffs in the reserves support vegetation including *Machaerina sinclairii, Phormium cookianum, Gahnia pauciflora, G. setifolia,* koromiko, *Coprosma robusta* and *Gaulthera paniculata* with some grassy patches.

Willow trees grow along many parts of the river bank detracting from the scenic qualities of and competing with the native vegetation. It is known that willows in the study area do become undercut and slide into the river (this is also due to the trees weight and possum browsing which kills the trees) causing snags. The contribution of the willow trees further upstream to the snagging problem is not known.

Conclusion

Within the Reserves there is a full range of vegetation types from semi-coastal forest to inland tawa and hard beech forest. Karaka, kohekohe and puriri are abundant in the lower semi-coastal parts of the Reserves no further than about 13 kilometres inland. From this point tawa and beech forests are more abundant. In addition to this horizontal zonation of vegetation from the coast inland, there exists vertical zonation on blocks rising from the river bank to approximately 400 metres above sea level. Other important botanical associations include *Cyperus ustulatus, carex spp.* and *Leptocarpus similis.*

The diverse range of habitats and the large size of the Reserves makes for a very high number of native plant species. The Mokau River reserves are important both for the full range of vegetation types and the large stands of semi-coastal vegetation, relative to the Taranaki Land District and New Zealand in general.

The 86 hectares of semi-coastal forest reserved within Mokau River Reserve is approximately 60% of the total area of the semi-coastal vegetation type presently reserved within the land district. The other 40% is scattered through 17 other Reserves. The largest single remnant being 19 hectares is Ratipihipi Scenic Reserve. Mokau River Reserve is therefore of Scientific importance on a National level.

REFERENCE INFORMATION

Department of Lands and Survey, New Plymouth, 1984:
Mokau River Scenic Reserve Biological Survey - Draft Report
Department of Lands and Survey File 13/4
Mokau Scenic Reserve

WATER RESOURCES AND USE

Introduction

This section discusses hydrological, water quality, and water use aspects of the Mokau River catchment. Information is generally sparse, with most data having been collected over a short period only. This is partly due to a lack of interest and local responsibility until recently - it was only in 1973 that the Mokau River catchment came under the jurisdiction of the Waikato Valley Authority.

While fish and wildlife are discussed in the Fauna section, no information is available about other forms of water life (eg, algae, invertebrates). The Waikato Valley Authority however has plans to carry out a biological survey of the Mokau River.

Hydrological Aspects

The Mokau River rises in the Hauhungaroa Ranges to the northeast of the study area and initially flows north-westward across the Maraeroa Plateau. It then assumes a southerly course and is joined by several large streams before dropping 13 metres over the Wairere Falls and entering the Totoro Gorge. In the gorge it is joined by two large tributaries the Mokauiti and the Mangaotaki. Downstream of the gorge, the river continues in a southerly direction until Panirau Island, where it abruptly changes course and follows a tortuous course between steep cliffs of sandstone covered in dense native bush for nearly 50 kilometres west to the sea. The Mokau has a total length of 158 kilometres and a catchment area of 1430 square kilometres.

The Ministry of Works and Development (Water and Soil Division, Hamilton) has been operating an automatic water height recorder at Totoro Bridge (GR N91:431517) since April 1979. This site is situated 73 kilometres from the Mokau rivermouth and drains a catchment of 1046 square kilometres. Consequently the discharge of other catchments into the Mokau River further downstream and their affect on the Mokau River itself, are not known.

Table 2

Daily Mean Water Flow at Totoro Bridge, Mokau River 1981
(cumecs)

	Minimum	Maximum	Mean
January	8.8	28.9	16.9
February	5.8	20.4	9.5
March	5.0	40.4	10.1
April	5.7	57.2	20.3
May	10.7	43.2	20.7
June	17.4	152.1	68.6
July	25.6	151.0	66.4
August	38.2	195.2	71.0
September	29.1	105.2	45.2
October	15.6	65.6	31.1
November	9.5	28.5	15.4
December	12.1	78.4	27.4

Source: Ministry of Works and Development (Water and Soil Division, Hamilton).

Table 2 demonstrates a wide variation in minimum and maximum flows, with a minimum of 5.0 cumecs, and a maximum of 195.2 cumecs in 1981. These figures represent mean flows over a 24 hour period, so that there has been some averaging out, and flows at any particular moment of time during the 24 hour period could be lower or higher still, and thus have an even greater affect on water levels in the river.

The annual flow curves at Totoro Bridge for 1981 and 1982 are shown in Figure 6. The high peaks correspond to flows generated by storms. The sharpness of these peaks indicates that the catchment has no large groundwater storage which would tend to dampen the general peak of winter flow. For draughting reasons it has not been possible in presenting this flow curve to show small but rapid fluctuations in river height which are the result of the impact of the two hydroelectric power stations on the water flow.

Fluctuations in water level caused by the influence of the tides have not yet been studied. However, local informants report that there is a time difference of about three hours for tidal fluctuations between the Mokau River mouth and Mangatoi Station (35 kilometres upstream).

WATER LEVEL READINGS, MOKAU RIVER, TOTORO BRIDGE.

SOURCE : WATER & SOIL DIVISION, M.W.D. HAMILTON

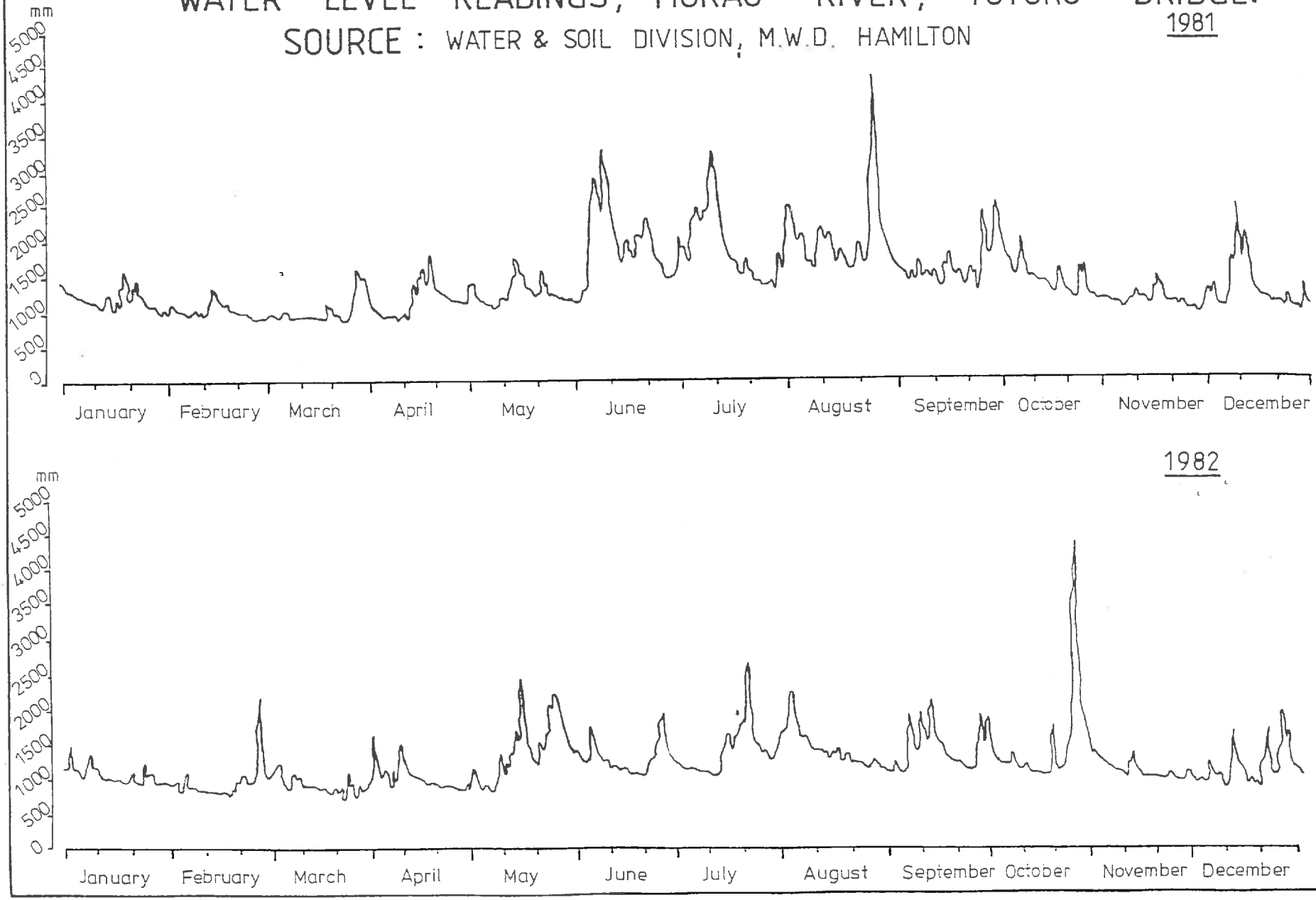


Fig 6

Flooding on the Mokau River is broadly related to two factors. First, rainfall and second, human activities. While the river regularly floods in winter, the highest floods occur in January and February after a summer dry period. Significantly larger floods occurred in 1940 and 1949. These floods covered farmland at Awakau with two metres of water and blocked the main road at Mokau, requiring supplies to be flown in. An even larger flood occurred in 1915. Heavy rainfall in conjunction with active land clearing on Mangatoi Station and further upstream, raised the water level at the Maryville Mine entrance by 20 metres. Silt and debris introduced into the Mokau River caused blockages and snags - some of which still exist today. Much of the material brought down by the 1915 flood was deposited at the Mokau rivermouth in the vicinity of what is now the Tainui Domain.

While a flood as large as the 1915 event is rare, and may never reoccur unless similar levels of human activity regarding land clearing take place, it is not improbable that events as large as the 1940 and 1949 floods, which were more related to rainfall, could reoccur. This has serious implications for farms and the riverside track to Mangatoi Station.

Local inhabitants claim that today the river responds faster to high rainfall in the upper catchment than ever before due to willow and other plant clearing operations along the riverbank.

Within the study area, the responses of tributaries to high rainfall is related to their catchment size, valley width and the steepness of the valley slopes. Stormbursts over relatively large, narrow and steep-sided stream valley catchments result in a sudden surge of a large quantity of water downstream. Precisely how much water, and how fast it flows and responds has not been measured, as these comments about tributary flow come from people who live at Mokau and regularly travel up the river. Their localised impact could be quite dramatic, with erosion scars created, and possibly debris blockages of the Mokau River which could result in flow surges when the blockages are cleared.

Water Quality

Water quality data has been gathered by the Waikato Valley Authority from four sites on the Mokau River at monthly intervals since April 1983. The four sites are: (i) Eight Mile Junction N83 : 626707; (ii) Wairere Falls N91 : 534565; (iii) Totoro Road N91 : 431516 and (iv) State Highway 3 at Mokau township N91 : 169358. Although observations are only over a short period, some features have already become apparent.

The river water temperature is generally stable but ranges between 9 degrees and 21 degrees Celsius and has a definite summer peak-winter trough pattern. This trough is not so noticeable at State Highway 3, as at other recording stations, probably owing to the widening and shallowing of the river at the estuary which facilitates a greater heat exchange between the river, atmosphere and solar radiation than further upstream.

Dissolved oxygen ranges between 8 and 12 g/m^3 which is well above the minimum (5-6 g/m^3) required for the maintenance of organic life. As dissolved oxygen is related to water temperature, there is a rise in dissolved oxygen corresponding to the trough in water temperature and a decline in dissolved oxygen corresponding to the peak in water temperature.

Turbidity and suspended solids are closely related. Generally turbidity is low and constant and likewise, the suspended solids are low being usually less than 15 g/m^3. High river flows will, however, greatly elevate these values as a result of the increased sediment load caused by water erosion and disturbed turbulent water flows. Another feature is that turbidity and suspended solids increase downstream to the river-mouth, indicating the erosion contribution of tributaries and riverbanks.

Biochemical oxygen demand (BOD) is a chemical assay used to measure the amount of oxygen required to stabilise decomposable organic matter in a sample. In general BOD of the Mokau River is less than 1.5 g/m^3 which is a normal value for a river of this type but, like turbidity and suspended solids shows a marked increase during periods of highest flow. This is related to the increased organic matter content which is washed off the surrounding land surface into the river.

Thus the water quality of the Mokau River can be described as apparently healthy, showing little or no pollution. There is a regular seasonal pattern of change in temperature and dissolved oxygen and periodic changes in turbidity, suspended solids and BOD caused by flood events and high winter rainfalls.

No faecal colliform or nutrient status data is available, so it is not possible to give a full assessment of the river's water quality. However, because of the nature of the catchment through which it passes, the waters are unlikely to be seriously polluted. The main potential for pollution comes from farm runoff.

Water Use and Management

Within the Mokau River catchment forty-five water rights have been issued by the Waikato Valley Authority, seventeen to discharge into; thirteen to take water from; nine to divert; and six to dam the Mokau River or its tributaries. Only one of the water rights is located within the study area. From the information received from the Waikato Valley Authority (Pers Comm 1984) it was determined that most of the licences for water discharge were for river control, soil conservation, drainage and water resources control and construction and maintenance works. The drawing off of water is used largely for agricultural purposes such as dairying, piggeries, stockyards and irrigation excluding stockwater. Another major drawoff use was institutional water supply. Licences for diverting the water were for construction and maintenance works, river control, soil conservation, drainage and water resources control. Licences have been issued for damming the water mainly for hydro electric power generation. Because of the salt water contained in it due to tidal influences, water is not generally drawn off the Mokau River for farm use in the study area. Water is instead obtained from springs usually flowing from the ground at a boundary between different rock types.

The Waitomo Electric Power Board is a major 'user' of water from the Mokau River catchment. Its two small run-of-the-river hydro schemes generate power during peak demand periods at Wairere Falls and on the Mokauiti Stream. The peak demand usually occurs in the evenings or during ship loading operations at Taharoa with reservoir storage capacity

allowed to build up during the day. Fluctuation in the level of the reservoir at the Wairere Falls stations is never more than 0.3 metres. Low river flows sometimes lead to a situation of no electricity generation but the biggest general problems are weed and stock carcasses. Siltation is not much of a problem.

Other water 'users' include canoeists, jet-boaters, swimmers, sightseers, whitebaiters, fishermen and hunters and are described in more detail in the Recreation Section.

Control over consumptive use of the water is the jurisdiction of the Waikato Valley Authority under the Water and Soil Conservation Act 1967. Use of the water for transport and navigation purposes, and use of the riverbed and river foreshores is governed by the Harbours Act 1950. Under that Act and by virtue of a grant of control authority (New Zealand Gazette 1983 page 1372), the Waitomo District Council is responsible for a 21 year period of up until 30 April 2004 for the Mokau River from just above the Wairere Dam down to the sea. The remainder of the Mokau River would be under Crown control for as far as it remains navigable. The standard five knot boating speed rule has been relaxed on the Mokau River downstream of the Wairere Dam (New Zealand Gazette 1981 page 2333) to allow jet boating activity.

Conclusion

Assuming that the automatic water height recorder at Totoro Bridge is representative of the freshwater flow of the Mokau River, it can be said that the river exhibits a large variation in water flows with a seasonal winter peak in discharges. Other discharges downstream of the recorder, and the tidal influence, have not been consistently recorded, so that, there is a large gap in Hydrological knowledge about the Mokau River.

This gap also extends to the Biological aspects, and, because of the lack of knowledge about the faecal colliform and nutrient status parameters the Water Quality aspects of the river are only partially known. The river does, however, appear to be generally healthy. There is little direct or consumptive use of the Mokau River and its tributaries water, but significant 'indirect' usage for transportation, fish-shellfish-bird resources and hydro-electric generation occurs.

In addition to the lack of data and understanding about some aspects of the Mokau River described above, tributaries and ground-water flows in the study area have not yet been studied and consequently are also not understood.

REFERENCE INFORMATION

1. Ministry of Works and Development (Water and Soil Division, Hamilton), Daily Mean Discharges and Water Level - Totoro Bridge, Mokau River, January 1979 - May 1983.

2. Waikato Valley Authority (Hamilton), Water Quality Data, Mokau River.

3. Allan Singleton, Ministry of Works and Development (Soil and Water Division), Hamilton. (Pers. comm).

4. Kevin Steele, Waikato Valley Authority, Hamilton. (Pers. comm).

EROSION

Introduction

The study area largely comprises Class VI to VII land units, with other less extensive areas of Class III and VI land (New Zealand Land Resource Inventory Worksheets). Closer examination of the Worksheets reveals that the major kind of limitation to sustainable productive land use in the study area is erosion. Thus, for any proposed development in the study area, erosion is an important factor to take into consideration.

This section describes the present and potential erosion status of the rocks and soils of the study area.

Present and Potential Erosion

The degree of present erosion, as shown on Table 3, is recorded on an aerial basis (for sheet and wind erosion) or on a basis of seriousness (for slip, flow and streambank erosion). In general, most of the study areas erosion types briefly described below are of slight to moderate intensity. Small portions of severe erosion intensities do, however, also occur. On low angled slopes (less than 15 degrees) erosion is a negligible problem. Such areas comprise the uplifted marine terrace surfaces described earlier in the geology section of this report.

TABLE 3 : MOKAU STUDY AREA - PRESENT AND POTENTIAL EROSION

LAND USE CAPABILITY CLASS	SLOPE (%)	EROSION PRESENT	EROSION POTENTIAL
VIII	35	Slight-severe debris avalanche	Very severe sheet and soil slip
VII	26-35	Slight-moderate soil slip, sheet and gully	Severe soil slip Moderate sheet and gully
VI	16-35	Nil-slight sheet, slip and wind	Slight-moderate sheet and soil slip, moderate earth flow
IV	8-20	Nil-slight earthflow	Moderate-severe sheet and rill when cultivated
III	8-15	Nil-slight sheet and rill	Slight-moderate Sheet and rill when cultivated

Debris avalanches occur on steep (greater than 26 degrees) sided slopes under a good vegetation cover. Due to a very high water content these are a particularly rapid type of flow which characteristically form a long, often v-mapped narrow track, tapering uphill at the head.

In contrast earthflow is a slow to relatively rapid flow of soil on gentle to moderate (8-25 degrees) slopes usually occurring in plastic or fine-grained non-plastic material. Characteristically, subsurface soil movement forms a deposit that bulges at the toe, with a depressed and fissured centre upslope, and slipping or slumping at the head of the flow. The silty clay nature of the soils lying on impervious mudstones forms the environment for earthflows. This is because clays liable to shrink and swell help to form cracks during drought conditions. Water penetrates these cracks saturating the soil, consequently reducing the resistance of clays to movement in the lower horizons and increasing pressure on the soil through the weight of and pore pressures generated by the extra water. Consequently blocks of relatively dry upper soil layers can be transported downslope quite rapidly. Earthflows are a common erosion feature at sites where the native vegetation has been removed for pasture grass.

Debris avalanche and earthflow are relatively rapid types of mass movement always associated with a change in material shape. Distinctly different are a group of common mass movement phenomena predominantly of a sliding or slipping character. Rapid sliding movements of the soil and subsoil parallel to the slopes, exposing subsoil or rock and creating hummocky heaps of rubble is known as soil slip. It is particularly common in the study area on moderate to steep (21-35 degrees) slopes - especially where the native vegetation has been removed. It tends to be precipitated by localised cloudbursts creating high intensity rainfall.

The two principal forms of surface flow erosion by water are sheet erosion and channel flow erosion. Sheet erosion occurs on steep (25-35 degrees) forested slopes where raindrop-generated muddy splashes flow as a sheet. In contrast water flow may become concentrated into rills, gullies or valleys creating channel flow erosion.

The scouring of soft, unconsolidated sediments in the valley floors by moving water as a process of streambank erosion occurs but, along with wind erosion, is relatively rare. However, a combination of soil slip and streambank scouring often results in portions of the Mokau riverbank, with entangled willow trees, sliding into the river. These trees contribute to the snags and blockages which often obstruct passage or detract from the scenic qualities of the river. Another area of active streambank erosion is at the mouth of the Mokau. In fact rock groynes were built in 1980 by the Ministry of Works and Development to control erosion on the northern bank of the Mokau River. Streambank erosion is of such intensity as to have recently necessitated the removal of two cottages at the end of Point Road in Mokau township.

The study area's potential for erosion (which is assessed by D.S.I.R. under an actual or assumed grassland cover with average farm land management and no soil conservation measures applied) is also described in Table 3. It can be seen that the land classified as suitable for pastoral or forestry use (Classes VI and VII) has a moderate to severe

potential for sheet, soil slip, gully and earth flow erosion. Land suitable only for protection purposes (Class VIII) has a soil slip and sheet erosion potential that is very severe. Finally, the land suitable for cultivation for cropping (Classes III and IV) has a sheet and rill erosion potential that is slight to severe.

While present erosion is generally of slight to moderate intensity or extent, farming on the steep slopes could cause severe erosion problems. This feature is illustrated by the erosion in the head of the Mokauiti Stream catchment between Mapiu and Aria, north of the study area. Erosion is affecting the catchment in three ways:

(1) Causing a physical and irreversible loss of productive topsoil.

(2) Causing a buildup of silt in the downstream water courses, changing their hydrologic characteristics and aggravating flood conditions.

(3) The deposition of silt laden flood waters causes considerable damage to pastureland resulting in the under-utilisation of potentially high producing soil types.

The Waikato Valley Authority (1980, 1982) has prepared a soil conservation strategy for the Mokauiti catchment involving first, measures to curb the serious erosion in the head of the catchment and to stabilise other parts of the catchment and second, river alignment and control works.

In an afforestation report (which has recommendations appropriate for many developments in the study area) appraising the Mangapapa B2 Block from a water and soil management point of view (Mangapapa B2 Block 1977) the Waikato Valley Authority recommended that:

(1) Class VIIIe and VIIe land should remain in their present cover, considering the erodible nature of the soils and underlying lithologies on high degree slope angles.

(2) The Mokau River and its tributaries have a riparian strip maintained to ensure protection of the waterway, and

(3) That roading and other works take into account the erodible nature of much of the study area and that appropriate techniques be adopted.

The Natural Gas Corporation has probably had more experience than anyone else with erosion in the study area as their pipelines cover considerable distances over every type of terrain. The Corporation is presently working to stabilise land on the right bank of the Mokau River as a consequence of the part their activities have played in initiating slope movements. A large crib wall at Mohakatino was, however, constructed because of the need to widen the ridge to accommodate the Maui pipeline, in addition to the Kapuni line previously laid. The wall was not built to specifically control natural erosion in the area.

Papa Rock Stability

The stability of papa rocks is not related primarily to the intact strength of the rock but rather to the presence or absence of swelling clay minerals (usually calcium-montmorillinite). Papa rocks that contain swelling rocks often suck in water and soften, causing a slump or develop into an earthflow. Other shrink-swell problems may cause cracking and distortion of buildings or even cyclinal creep of a building down a slope. Another problem is that general assumptions about moisture and compaction properties of unconsolidated materials do not apply for papa materials that contain swelling clays.

If no swelling clays are present, then the papa rocks can stand vertical to great heights. For example, some river cuttings in the Mangaweka Gorge are 120 metres high.

Within the study area such swelling clays have not been found in the sandstone layers of the Mokau Group. Mohakatino sediments are expected, however, to contain such clays.

Conclusion

Within the study area there is a variety of erosion types largely reflecting the topographic, or slope, factor. Because of the nature of the terrain which is generally steep with a good vegetation cover, mass movements are predominantly slip or flow types. Less extensive areas of sheet, streambank and wind erosion types also occur. Where slope angles are low, erosion is negligible aside from stream or riverbank erosion.

Most of the study area's erosion types are presently of slight to moderate intensity. However, insensitive human interference through tree felling, farming and road or building construction could easily trigger off severe erosion problems.

While papa rocks often present serious stability problems, these cannot be evaluated in the context of the study area until the nature of the clay minerals (swelling or non-swelling) contained in the material has been determined.

REFERENCE INFORMATION

1. National Water and Soil Conservation Organisation, 1979: New Zealand Land Resource Inventory Worksheets (N82, 83, 91, 92, 100), Ministry of Works and Development (Water and Soil Division).

2. New Zealand Department of Scientific and Industrial Research and the New Zealand Geomechanics Society, 1977: Slope Stability in Urban Development, D.S.I.R. Information Series No. 122.

3. Soil Conservation and Rivers Control Council, 1969: Land Use Capability Survey Handbook, Ministry of Works (Water and Soil Division).

4. Waikato Valley Authority, November 1980: Mokauiti River Catchment Control Scheme.

5. Waikato Valley Authority, June 1982: Economic Evaluation - Mokauiti Catchment Control Scheme.

6. Waikato Valley Authority, October, 1977: Mangapapa 2B Block.

FAUNA

Introduction

The Faunal distribution in the study area can be seen to change moving up the Mokau River from its mouth as the climate and vegetation change and the tidal influence diminishes. For reasons of convenience the faunal resources are described in terms of five zones:

i	Mokau Estuary	ii	Land adjoining the Lower;
iii	Middle and	iv	Upper reaches of the river;
v	and the Mokau river.		

During 1980 and 1981 the Wildlife Service carried out fauna surveys in squares surrounding the Mokau River. Fisheries data from the Ministry of Agriculture and Fisheries (Fisheries Research Division) in conjunction with some local knowledge completes the data used in this section.

While native and introduced animals are described, this section is based on surveys that were carried out in native bush zones and others on the Mokau River.

Mokau Estuary

This zone is a tidal rivermouth of very good quality - a habitat rare on the Taranaki coast. It extends from the Mokau rivermouth to about 6 km upstream, although the tidal influence extends about 40 km upstream.

Birdlife observed includes predominantly coastal species such as the Variable Oystercatcher; Pied Stilt (*Poaka*); White faced Heron; Black-backed Gull (*Karoro*) Red-billed Gull (*Tarapunga*), and Reef Heron (*Matuku-Moana*) as well as freshwater species including the Black Shag (*Kawau);* Mallard; Grey Duck (*Parera*) and Kingfisher (*Kotare*). Blue Penguin (*Korora*) are also occasionally seen.

Pukeko and Bittern (*Matuku*) have been observed further south at the Mohakatino River mouth and on the Waihi Stream and may be assumed to also inhabit the Mokau River mouth.

These bird species indicate the presence of crustacae and shellfish; as well as worms, snails, land and water insects (dragonflies, grasshoppers, blow flies) and fish. Frogs, native snails and skinks (*Cycloderia aerea)* have also been observed.

Lower Bush Reaches of the Mokau River

This zone is an area of native bush rising from the river to 200m above sea level. The bush has been extensively modified through milling and grazing by cattle (reflecting farming activities in the Awakau region) feral goats and pigs, and possums but still retains a good variety of plant species.

Birdlife differs from that at the coastal zone because of the different vegetation (providing leaves, flowers and fruits for feeding as opposed to shellfish and crustacae in the estuary)and the less significant tidal influence. Species observed include; New Zealand Pigeon (*Kereru*); Kingfisher (*Kotare*); Tui; Shining Cuckoo (*Pupiwharauroa*); Grey Warbler (*Riroriro*); Fantail (*Piwakawaka*); Silver-eye (*Tauhou*); Yellow hammer; Chaffinch; Goldfinch; Pheasant; Harrier (*Kahu*); Blackbird and Hedgesparrow.

Bittern (*Matuku*) have been sighted in a now drained swamp in this zone and Kiwis have also been reported.

In addition to feral cattle, goats and possums, ferrets are also occasionally present.

Middle Bush Reaches of the Mokau River

Further upstream to Panirau Island and in the vicinity of the Totara and Mangapohue Stream catchments, vegetation has been less modified and the relative isolation accounts for a zone of even wider variety of bird species.

Birdlife observed includes the Tui; Fantail (*Piwakawaka*); Grey Warbler (*Riroriro*); Shining Cuckoo (*Pupiwharauroa*); Morepork (*Ruru*); Pied Tit (*Miromiro*); and Chaffinch. Less common species are Bellbird (*Korimako*); Rifleman (*Titi pou namu*); Whitehead (*Popokatea*); Long-tailed Cuckoo (*Koekoea*); New Zealand Pigeon (*Kereru*); Blackbird; Greenfish; Harrier (*Kahu*); Falcon (*Karearea*); Robin (*Toutouwai*); Kaka and Kiwi.

On the river, which is very slow flowing in this area, the following birds were observed: Mallard; Grey Duck (*Parera*); Paradise Shelduck (*Putangitangi*); Black Shag (*Kawau*); Little Shag (*Kawaupaka*); Pukeko; Kingfisher (*Kotare*); Harrier (*Kahu*) and Southern Black-backed Gull (*Karoro*).

Species of rats were also numerous in this area.

Upper Bush Reaches of the Mokau River

This zone is characterised by small scattered patches of Tawa Forest and larger patches of scrub consisting of gorse and pigfern. The occurrence of Californian Quail can be attributed to these scrub patches which are also the habitat of the Giant Weta. In addition to many of the birds found in the middle zone Blackbird; Starling; White-backed Magpie and Song Thrush are present reflecting the general open-pastoral nature of the vegetation.

Despite an abundance of tomos and caves, typical of limestone country north of the study area, no bats have been observed.

Mokau River

The Mokau River has the reputation for being the most productive whitebaiting fishery in Taranaki. A survey by the Taranaki Catchment Commission (1981) suggests that the river supports an important recreational and commercial whitebait fishery. As such the River is, by implication, an important whitebait habitat. Whitebait are fished up to 35 km inland - this being the significantly tidal affected area. The whitebait are recognised as belonging to the five species of Galaxid of which the best known in Taranaki is *Galaxias maculatus (inanga)* .

Assuming the stocks of whitebait are local, a preliminary assessment of the potential whitebait spawning habitats in Taranaki rivers was undertaken in the 1981 survey. Suitable sites for spawning are the banks of tidal rivers where the ground is covered by the highest spring tides but not normal high tides. The type of bank most normally selected and regularly used by the spawning schools are the low-lying rush and grass-covered portions over which the spring tides can creep. Fairly long, thickly-grown grass and rushes of similar vegetation is usually chosen. Along with the Tongaporutu, Onaero and Waitara rivers, the Mokau is thought to offer great potential for whitebait spawning.

Data obtained from the Ministry of Agriculture and Fisheries (Fisheries Research Division) from very brief and intermittent surveys of the Mokau River, and some tributaries also indicates the presence of native black mudfish (*Neochanna diversitis);* short and long finned eels *(Anguilla australis* and *A. dieffenbachii);* banded kokopu (*Galaxias fasciatus)* and koura (*Pararephrops spp.)* as well as introduced rainbow trout (*Salmo gairdnerii).*

Rainbow trout are not known to be present in the section of the Mokau River in the study area, however both brown and rainbow trout are fished around and above Piopio and in the river's largest tributary - the Mangaotaki River. The Auckland Acclimatisation Society (which last released trout into the river in 1975, indicating a presently self sustaining fishery) does, however, feel that it is ..."highly probable that there is movement of trout throughout the Mokau River system" - which would, assumably, cover the river in the study area.

Other species of fish found in the River include; trevally, flounder, mullet and kahawai. Sharks and stingrays have also been sighted in the estuary (George Honnor, pers comm) but snapper are no longer found.

Conclusion

As was seen in the vegetation section, it is clear that the variety of environmental conditions and the size of the study area have created a diversity of habitats for many species of birds, fish and other wildlife, of both freshwater and marine types.

From both a human use and an ecological perspective, the whitebait resource and the highly valued-spawning grounds need to be positively identified and protected. Wildlife officers also urge that feral goats, cattle, sheep, pigs and possums need to be eradicated to ensure the protection of both native animals and plants.

While no kokako have been sighted in the study area, and only one kaka, this is probably due to the brief nature of the wildlife surveys carried out. The area is a suitable habitat for both birds, and kokako are to be found to the north in the Herangi Range and to the south in the Waitaanga district. As part of a large bush covered area extending southwards to the Wanganui River, the Mokau River area meets the needs of the freer ranging birds such as kaka and New Zealand Falcon.

Robins reach the northern most limits of their distribution on the west coast of the North Island in the Mokau - Awakino locality.

REFERENCE INFORMATION

1. New Zealand Wildlife Service, 1981, wildlife survey information for squares surrounding Mokau River.

2. Ministry of Agriculture and Fisheries (Fisheries Research Division), Fish Distribution Data Base Search (Mokau River).

3. George Honnor, Honorary Ranger, Mokau.

4. O'Donnell, L.F.J., 1982, Habitat Distribution and Status of the North Island Kokako (*Callacas cinerea wilsoni*) in the Western King Country and Taranaki, 1977-81. New Zealand Wildlife Service Fauna Survey Unit, Report No 32.

5. O'Donnell, L.F.J., 1983, Wildlife Values of State Forests within the Western King Country Management Region. New Zealand Wildlife Service Fauna Survey Unit, Report No 35.

6. Taranaki Catchment Commission, 1980 Recreational Use of Water in North Taranaki.

7. Taranaki Catchment Commission, 1981 The Recreational Whitebait Fishery in Taranaki.

HISTORY

Introduction

Three district periods in the history of the study area can be recognised:

(i) prehistory Maori (to 1880)
(ii) coal mining and farming development (1880-1952) and
(iii) recent (1952-1985).

The important events which occurred during each period are described in this section.

While some historical aspects have been well documented (such as the Mokau Coal Mines) others have only been referred to very briefly in a variety of articles, reports, letters and other publications. Historical "gaps" or inconsistencies have where possible been clarified through conversations with many people who live in the area. Some of the sites are referred to in the following text, while others have not yet been located.

Prehistory Maori (to 1880)

In pre-European times the Mokau River was a major transport route for Taranaki and Waikato Maoris. The region, especially near the river mouth, was closely settled for the location providing strategic sites for fortified settlements (pa); fertile volcanic soils for horticultural activity; fish and shellfish gathering sites; bush covered hills exploitable for birds, fern roots and berries; and swamps as important sources of flax, raupo and watercress. Because of these natural resources and its strategic location as the "gateway" to Taranaki, the Mokau River area was a site of conflict between the Ngati Maniapoto of the Waikato tribal area, and the Ngati Tama of Taranaki.

One site often under siege was the Ngati Maniapoto island Pa at Motu-Tawa (situated in a bay in the Mokau River about one kilometre upstream from the rivermouth, and approximately one hundred metres out from the northern shore). Remnants of the palisade can still be seen in the sand around Motu-Tawa at low tide. Further upstream at Rangiohua cliff is the site of what is believed to be the most ancient pa in the district, occupied by the Tangata Whenua long before the arrival of the Ngati Maniapoto.

Facing the seacoast, at the back of Mokau township, is the site of the old Topapahihi Pa of the Ngati-Raku. This was the scene of a massacre by Te Rauparaha of Ngati Toa and his musket warriors during their migration southwards in 1821. During this migration a canoe capsized on the Mokau River and the only child of Te Rangi-haeaka (Te Rauparaha's nephew) was drowned.

Te Ane-pota is one of the numerous caves along the coast at the base of the cliff at Mokau. The Maoris scraped a reddish sediment (Kokowhai or red ochre) off the walls, using it for colouring canoes and wooden articles. This cave forms an underground lagoon beneath part of Mokau township and was used, for a time, to supply the township's water.

Groves of Tainui trees (*Pomaderis apetala*) growing near the heads are said to have sprung from the rollers, skids and flooring of "Tainui" canoe which is said to have brought the Ngati Maniapoto and other Waikato tribes to Kawhia and, soon after, to Tongaporutu, Mokau and Awakino. The sandstone rock in the Mokau estuary on which the Tainui canoe was said to have been anchored (hence the name Tainui Anchor), was discreetly moved in 1926 to Maniaroa cemetery near Awakino following some "official" proposals to move it to Auckland.

The first Europeans known to have been in the area were the trader Thomas Ralph and a seaman known simply as "Tommy". About 1832 Ralph set up a dressed flax trading enterprise but this was of short duration as he and his wife were kidnapped by another Waikato taua (hostile expeditionary force), while his Ngati Maniapoto hosts were absent in Taranaki. After being rescued by a neighbour trader, Ralph and his wife left for a safer post on the East Coast.

Missionaries were next to be attracted to the Region. Wesleyan, Catholic and Lutheran missions were established along the river in the early 1840's. In 1841 the Reverend George Buttle founded a Wesleyan mission station at Te Mahoe. From 1844 to 1858 the Reverend Court Schnachenberg developed this station which was finally used by the Reverend Hone Eketone from 1858 to 1862. The site is presently marked by a Historic Places Trust signpost about two kilometres along the Mokau River Road.

Other notable early European visitors include Dr Dieffenbach, Edward Meurant, Bishop Selwyn and Hans Turton. Exploration of the Mokau District in 1841 by Captain Moore resulted in the first sighting of coal deposits on the river by a European.

With the outbreak of the Taranaki Wars, or "te riri pakeha" (the Europeans impatience) in early 1860's, the area around the Mokau Heads became almost devoid of Europeans. It remained so even after the Wars ended, for the Mokau River fell within the aukati or boundary line of King Tawhiao's territory which Europeans were forbidden to enter by the "Kingite Maoris" - and discouraged from doing so by the Colonial Government. Maori life continued much as before from 1860 to 1880.

Coal Mining and Farm Development (1880-1952)

The beginning of the end of the Kingite isolation beyond the aukati was marked by a geological survey up the Mokau River carried out in 1878 by James Hector (Director of the newly established Geological Society) with the assistance of influential Government officials and Ngati Maniapoto chiefs. On this journey five tons of coal were taken on board the steamer "Hannah Mokau" for testing. Hector was most enthusiastic about the results.

However, due to significant problems in raising finance to establish a mine and legal difficulties in obtaining clear title to the land, mining did not begin until 1884 at what is known as the First Stockman Mine.

Between 1884 and 1952 eight mines were worked in the Mokau River area. The periods of operation of these mines and their outputs are shown in Table 4.

TABLE 4

Mine	Name of Mine	Dates Operating	Tonnage
N91/M1	Stockman No 1	1885-85; 1921-52	20,498
N91/M2	Maryville	1885-86; 1890/1915	87,951
N91/M3	Cooperative	1891	940
N91/M4	Fernside	1898-1901	3,465
N91/M5	Lower Stockman	Pre 1917; 1937	*
N91/M8	Mokau	1932-33	4,288
N91/M9	Stockman No 2	1938	*
N91/M10	Stockman No 3	1939	*
N91/M30	Valley Opencast	1953-66	75,948
N91/M34	Valley Collieries No 1	1956-59	5,171
N19/N39	Valley Collieries No 2	1960-67	28,484

* = Output included in figures for N91/M1 Stockman No 1

Total Output 1890-1967 226,745 tons or 230,000 tonnes

SOURCE: NZ Department of Mines, Huntly, quoted in H.R. Barr thesis: The Mokau Mines

Other Mines Department records also list the short lived Bombay Mine which produced 49 tons of coal between 1896 and 1898.

The largest Mokau Mine, the Maryville or Old Mine, worked a single underground seam between 1.7 and 2.1 m thick and produced 87951 tonnes of coal between 1885 and 1915. All the coal was taken by steamers and launches down the Mokau River and along the coast to Waitara and New Plymouth where it was mainly used in the freezing works and dairy factories, as well as settlers' fires and other smaller industries.

The miners, their wives and families endured an arduous and difficult life at the Maryville settlement situated opposite the Maryville mine 33 kilometres upstream on the left bank of the Mokau River. In the 1911 Census, the settlement had 18 males, 7 females, 9 or 10 houses and singlemen's quarters as well as buildings associated with the mine (manager's office, minestore, blacksmith's shop and magazine), a post office (in the manager's office) and a school (which was never used).

It was not, however, financial or legal difficulties but the deterioration of navigation through snagging and flooding and the treacherous nature of the river mouth bar which led to the decline of the Mokau River mines. Other contributing factors included labour shortages and a decline in local demand for coal. The Maryville Mine closed in 1915 following a particularly severe flood, and in 1952 Stockman No 1 mine ceased operations - ironically it had been the first to commence mining.

Not long after coal mining began, a limestone kiln was constructed to burn lime quarried from a ridge not far from the kiln. The kiln was built sometime before 1895 and is variously attributed to Mr Secombe and a Mr Lloyd. Burnt lime transported away on boats was however, highly reactive with water and often caught fire. Consequently operations ceased soon after they started.

Another quarry seven kilometres from the river mouth on the south side, was operated by the Public Works Department between 1924-26. The location of this quarry is now marked by a Lawsoniana plantation.

In addition to the coal mining industry vast quantities of high grade timber were exported in scows direct to overseas markets from loading points on the Mokau River. Some of the names of the mills which have been recorded are Kelly's, Rothery's, Dive's and Greenway's. A Mr Christofell took over an old mill (probably Dive's) and operated it from 1918 to the middle of the 1930's.

The Mokau Harbour Board was established on 18 December 1800 to handle the growing river and harbour usage by a variety of vessels. A signal station erected on the southern Mokau Heads in the 1900's was used regularly until the mid 1930's. The Harbour Board Minutes show that the Board spent most of its efforts on trying to correct the problems of snagging in the river. A big flood in 1915 brought down many snags which blocked the river channel and subsequently, greatly reduced shipping. Expensive snag clearance equipment, which required heavy maintenance, was acquired but continual breakages made the proposition uneconomic and impracticable. Even up to the early 1930's, floods regularly rose up to the height of the Awakau Bridge over onto the flat land which until drained by the Sutton brothers, was largely still swampland.

The farming history of the area greatly follows the regional history of farming in Taranaki. About the time of the Big Flood in 1915, the "Boom Period" of farming in Taranaki, brought about by the Liberal Party's land policies, profitable economic conditions and a demand for land, was coming to an end. By then the Taranaki lowlands were occupied and some drainage was taking place. Farming frontiers had advanced into valleys and the hill country. Mangatoi Station, the largest farming enterprise in the study area, was carrying about 10,000 sheep and also had dairy cattle on flat land at Awakau. About twentyfive people lived on the station which boasted a twelve stand woolshed, homestead, cookhouse, shearers quarters and school.

A change in economic climate brought about because of decline in the price of primary produce, led to a period of consolidation and limited expansion of farmland. From about 1925 to the late 1940's many farms in the Taranaki hill country were abandoned. Reversion of grassland to secondary growth (bracken fern and manuka) resulted in a period of farm decay and farmland contraction. Mangatoi Station, abandoned about 1947, was no exception. This station was probably abandoned later than many other similar farms due to the coal mining operations which in effect subsidised the regular transport connections, and to the excellent physical farmland conditions.

Downstream around Awakau, Mokau and Awakino, bushfelling followed by dairying was undertaken to provide a cash income to develop the farmlands. Opened in 1921, the Mokau Cooperative Dairy Company Ltd operated until 1959 when it closed as a result of a diminishing supply of milk to the factory, brought about by high wool prices.

A hand-winched ferry across the river at Mokau started operating in 1889, and continued until the Mokau River bridge was built in 1927. When it was opened, the 244 metre long, 4.4 metre wide reinforced steel and concrete bridge, with two passing bays and a lifting span that gave 20 metres clearance, was the most modern design in New Zealand. On account of the high cost of maintenance connected with it, the lifting span, last used to allow for the passage of shipping in 1940, was dismantled in 1960 and the decking restored to a permanent level. A rabbit gate on the bridge was removed about 1947 as a result of numerous complaints by motorists about the inconvenience of opening and closing the gate.

Closure of the dairy factory, in conjunction with the construction of the Mokau Valley Road and a bridge across the river at Awakau in the late 1950's brought about the end of the launch service operated on the Mokau River from Mokau to just upstream of the Awakau Bridge by the late Mr Eric Lewis. The launches, the "Sefton" and the "Cygnet" delivered parcels, stores, and mail to the settlers and collected cream in cans for the dairy factory.

The Tainui Domain Recreation Reserve, locally known as the Domain was originally a sportsfield containing a pavilion and concrete cricket pitch which provided locals with a good sports area. Over the years however, due to declining population, the domain has deteriorated in condition and appearance. A fresh revival of interest has only recently taken place.

Recent (1952-1984)

Since 1952, the study area has had a quiet history. Farms in the area have been cleared, drained, fenced and topdressed in areas that are not hindered by access or flooding. Farming on Mangatoi Station has been extensive in nature. The station has often been used by stock agents to "winter-over" flocks of sheep, and has generally been treated as a runoff property.

Probably the most significant events which have occurred in this period have been the construction of the Kapuni and Maui gas pipeline. Both pipelines caused significant economic (through the loss of farm labour) and social problems to the area. A large cribwall on a ridge on Mohakatino Station overlooking Mokau township built for the pipelines to stabilise the slopes against failure is now referred to as the "Great Wall of Mokau". The town has strengthened its service by establishing and maintaining a town hall, garage, school, St Johns Ambulance Station and Ministry of Works and Development Depot. In addition tourist facilities (which originally began with a boarding house that burnt down in the early 1840's) have been developed as the tearooms where the New Plymouth to Auckland Newmans bus stops, and enhanced by the establishment of a motorcamp in Mokau township, another three kilometres north on State Highway 3.

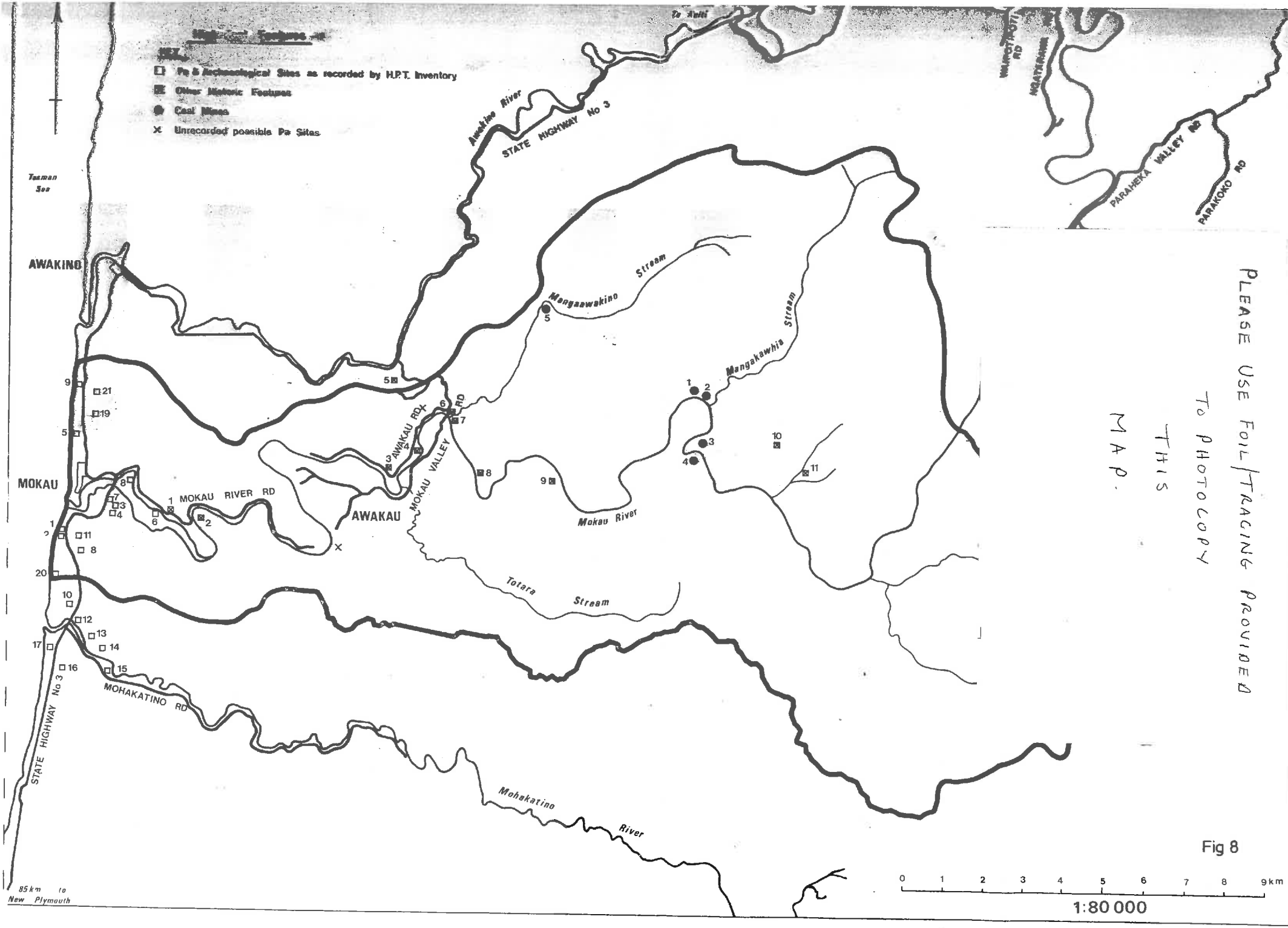
This period in Mokau township's history does not, therefore, differ significantly from any other small rural New Zealand township.

Outside the study area to the north, but still part of the Mokau coalfield is the Valley Collieries mine. This mine produced over 1,000 000 tonnes of coal by opencast and underground methods between 1952 and 1968. It was reopened in 1979 by Mr R. Farnsworth and has a current output of about 50 tonnes per week. A recent development has been a drilling programme connected with investigations into the remaining resources of the Mokau coalfield. This is discussed further in the Potential Development Section.

Conclusion

In the 1920's and 30's there was a saying that 'nothing ever prospers on the Mokau' (Mr Robert Wells, personal communication). Judging by the success of those people who financially and physically supported the coalmine and farming ventures on the river upstream from about the Awakau Bridge, the saying is apparently correct. However, no venture will ever prosper if it is not compatible with its environment - as the early pioneers in the study area soon, to their despair, found out. In general, the area's difficult topography forced transportation along the Mokau River but natural high water flows aggravated by silt and plant debris from land clearing operations, resulted in disastrous floods, log jams and snags which cut transportation links and eventually forced the coal mines, timber mills and farms to close down. Downstream of the Awakau Bridge, the topography was not such a problem and roads could be built to well-drained flatlands. Mokau township, starting as a small flax trading post at the Mokau rivermouth, has in the course of its varied history, passed through the dairy-factory phase so common to most New Zealand small towns. As people learnt the limitations of the environment they lived and worked in, so the size and functions of Mokau township have changed.

Important and prosperous during the Maori period because of its diverse and beautiful natural resources and the Mokau River provided an important transportation route, the study area today has declined in regional importance to become a small, busy, and obviously still important holiday retirement and farming area.



PLEASE USE FOIL/TRACING PROVIDED TO PHOTOCOPY THIS MAP.

Fig 8

INDEX TO HISTORIC MAP

Pa and Archaeological Sites as Recorded by H.P.T. Inventory

1	Pa and Midden	R18/1
2	Pa and Midden	R18/2
3	Pa and pits	R18/3
4	Pa Site	R18/4
5	Terraces and midden	R17/5
6	Pa with pits and midden	R17/6
7	Cave, Shelter, Rock art	R18/7
8	Pits and Terrace	R17/8
9	Pa Site	R17/9
10	Pa Site	R18/10
11	Pa Site	R18/11
12	Pa Site	R18/12
13	Pa Site	R18/13
14	Pa with pits	Q18/14
15	Pa Site	Q18/15
16	Pa, pits and midden	Q18/16
17	Pa Site	Q18/17
18	Pa Site	Q18/18
19	Midden and pits	R18/19
20	Artifact find spot	Q18/20
21	Pa with pits	R18/21

Coal Mines

1 Maryville
2 Fernside
3 Stockman
4 Cooperative
5 Mokau

Unrecorded Possible Pa Sites

Other Historic Features

1 Te Mahoe Mission Station
2 Old Quarry
3 Timber Mill
4 Kelly's Timber Mill
5 Old Quarry
6 Awakau Bridge
7 Timber Mill
8 Old School
9 Lime Kiln
10 Old burning seam
11 Old burning seam

REFERENCE INFORMATION

1. Barr, H.R., 1979: The Mokau Mines, University of Waikato - dissertation.

2. Department of Lands and Survey, 1909: Report on Scenery Preservation for the year 1908-9 Government Printer.

3. Allan R., for Mokau School Jubilee Committee, 1975: 80th Jubilee - Mokau School - 1975, Taranaki Newspapers.

4. Mr Ian Whittaker, Otorohanga (pers. comm.)

5. Mr Robert Wells, New Plymouth (pers. comm.)

6. Mrs June Hocking, Palmerston North (pers. comm.)

7. Members of the Tainui Historical Society (pers. comm.)

8. Roger Fyfe, Taranaki Museum, New Plymouth (pers. comm.)

9. NZ Historic Places Trust, 1983, Historic Places Inventory, Waitomo District.

10. NZ Historic Places Trust, 1983, Historic Places Inventory, Clifton County.

LAND TENURE

Introduction

Land and lease titles in the study area with the exception of smaller sections in the Mokau township are described in this section. Figure 9 shows the land tenure of the study area. As can be seen several tenures are recognised, the largest being Freehold and Maori land. The colourful history of the region, in conjunction with the usual problems encountered with regard to Maori land titles makes a title search in this area very time consuming.

Crown Land

Crown land consists of Mohakatino Farm Settlement and twentyfour sections of land on the North and South banks of the Mokau River forming the Mokau River Scenic Reserve.

Mohakatino Farm Settlement comprises 3331 hectares of land acquired from private ownership in 1959 with some minor additions in 1965. The blocks of reserve land have been variously set apart for scenic purposes since 1912 and presently constitute 2819 hectares. The reserve is classified as Scenic by New Zealand Gazette 1984 page 3972. Reserve boundaries are presently being altered as a result of additions from State Forest 56 km upstream on the southern bank of the Mokau River - and land exchanges further downstream on the river's northern bank.

Under Section 58 of the Land Act when Crown land is sold or disposed of, a strip of land at least 20 metres wide along the banks of waterways of greater average width than 3 metres is reserved from sale. The public has right of access along these strips of Crown land.

Such a strip of land borders land along the Mokau River. A further narrow strip of land not shown on Figure 9 is a 10 m wide right-of-way extending from the boundary between Part 5 D.P. 3836 Block III Mokau S.D. and a scenic reserve (Section 3 Block II Tainui S.D.) to Section 1 Block III Mokau S.D.

The control of the Mokau River foreshore, riverbed and waters from approximately one kilometre upstream of the Wairere Dam to the sea (as described in the First and Second Schedule of the Waitomo District Council Foreshore, Riverbed, and Waters Control Order 1983 New Zealand Gazette Page 1372) has been delegated to the Waitomo District Council through a Grant of Control for a period of 21 years from the 1st day of May 1983 and ending with the 30th day of April 2004. The remainder of the Mokau River is under Crown control as far as it remains navigable.

Crown Leasehold

Of the approximately 1300 hectares of Crown land in the Awakau - Mackford locality, 849.5 hectares is presently under a deferred payment licence to R.J. and K.H. Shewry and 453.4 hectares under a renewable lease to H.D.T. Cox.

Maori Land

Two large blocks of Maori land occur on the northern bank of the Mokau River while two much smaller sections occur further downstream on the southern side. The Mangaawakino Block on the northern side of the river comprises 3323 hectares in six separate sub-blocks. None of this Block has been farmed although parts have been selectively logged for native timber. The Mangapapa B2 Block also on the northern side contains 4675 hectares of which approximately 775 hectares is grassland, 2500 hectares of reverted grassland (scrub and regenerating native bush) and 1400 hectares of native bush. This block is currently administered by trustees on behalf of the owners. The Mangapapa B2 Block is a large and significant portion of the region, for not only does the coalfield lie centrally within the block but seven Scenic Reserves along the River are adjoined by this block. The Reserves are disjointed and it would be desirable to join them up into one continuous stretch of riverbank - to preserve scenic values, to protect river bank stability against erosion, to buffer the river environment from existing and potential uses of adjoining lands and to create a riparian strip.

Freehold Land

The 17716 hectares (approximately) of freehold land is shown in Figure 9.

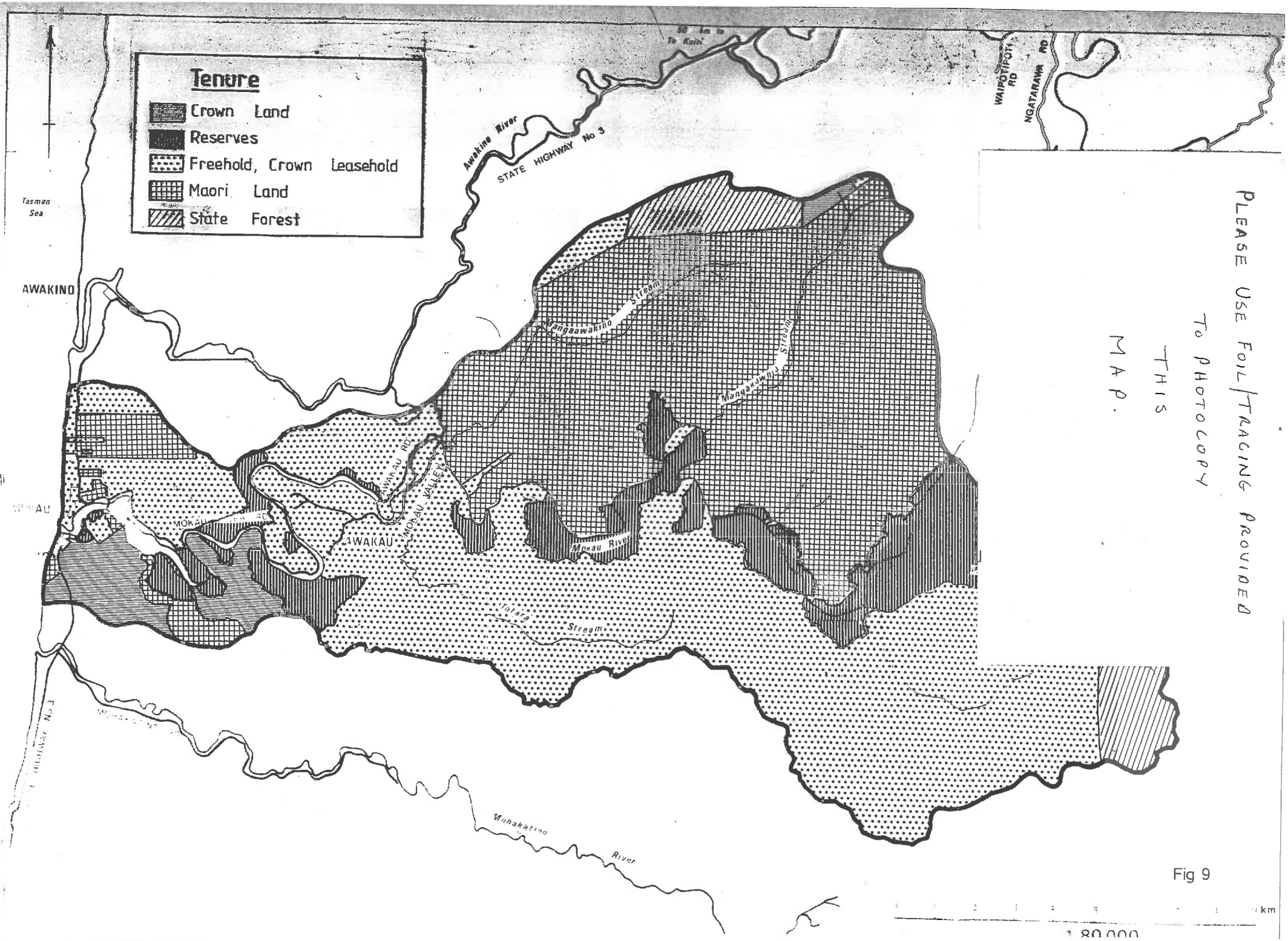
The largest freehold landowner of the study area until recently was the Institute for Environmental Studies Incorporated (Mangonui). The Institute has recently sold the land to the Sampson Brothers.

While the bulk of the Sampson Brothers land is in a large block, (often referred to as the Mokau - Mohakatino Block) the brothers also have title to several riverbank frontages adjacent to Lands and Survey Scenic Reserves (Lots 1, 2, 3, 4, 5 and 6 D.P. 7459).

The Sampson Brothers have acquired Ohura Timber and Coal Products which has timber, working and incidental rights over 4267 hectares of the land. The rights expire in October 1987. Clifton Lands held similar rights over 6662 hectares of the land. These rights expired on the 1st October 1983.

State Forest

Land administered as State Forest by the New Zealand Forest Service covers approximately 1326 hectares of the study area.


Tenure
Crown Land
Reserves
Freehold, Crown Leasehold
Maori Land
State Forest
Tasman Sea
AWAKINO
Awakino River
STATE HIGHWAY No 3
WAIPOTIPOTI RD
NGATARAWA RD
Mangaawakino Stream
Manganuiwhio Stream
MOKAU
MOKAU VALLEY RD
Mokau River
Inlet Stream
Mohakatino River
PLEASE USE FOIL/TRACING PROVIDED TO PHOTOCOPY THIS MAP.
Fig 9
km
1:80,000

REFERENCE INFORMATION

1. Certificates of Title.

2. The New Zealand Gazette 1983, Vol II.

LAND AND WATER USES

The information in this section has been derived from the Land Resources Inventory Worksheets, the Water and Soil Division (MWD), the District Schemes of the Waitomo District and Clifton County, the Local Authorities administering the area and comments from Lands and Survey Departmental Field Officers and Ranger Staff as well as field investigations.

The Waitomo section of the study area is described in the District Scheme as a traditional pastoral farming area in hill country with no horticultural developments or pressure to subdivide. There is little or no forestry development.

In Clifton County on the southern side of the Mokau River the land varies between steep hill country to the north, encompassing much of the study area, with alluvial flats towards the river mouth, where use is more intensive. The Clifton County describes much of the study area to be erosion prone land in indigenous cover.

This topography has resulted in mainly hard hill country pastoral farming with sheep and cattle grazing being the major agricultural uses. More intense and varied uses occur along the alluvial river flats and towards the coast and river mouth.

The coastal strip is a distinct unit within the study area, where State Highway 3 runs close to and gives access to the coast. In general this area of the coast has scenic, amenity and recreational values, of regional rather than national or local significance. Development both existing and desired is low key in nature with an emphasis on preservation of natural character. Lack of crowding and provision of only a basic range of facilities is highly valued by users who are significant in numbers and increasing.

Specific Land Use Patterns

Land use in the study area can be grouped into four broad categories namely - forestry, farming, conservation of natural areas, and other uses.

Forestry

There are no significant stands of exotic forest within the study area either on private or Crown land.

Indigenous forest occurs under state ownership and management and on private land. Much of the original forest within the region has been logged, burnt or cut-over to varying degrees. Sizeable blocks of forest in a primary state still exist within the study area, with a large proportion of these being under Department of Lands and Survey scenic reservation or managed as State Forest. No timber or other forest production takes place within the State Forests.

Much of the indigenous forest on private land has been selectively logged and this is still occurring although not extensively.

Indigenous forest is in varying stages of regeneration and is the predominant land use within the study area.

FARMING

Pastoral farming is the second largest land use within the study area. This consists mainly of hill country farming - extensive grazing of sheep and cattle for meat and wool purposes. On flatter alluvial areas there is more intense activity including dairying. It is noted in the Clifton County District Scheme that in the north of the County there are some indications of a move back to dairying from dry stock farming. Much of the hill country grazing of sheep is very extensive on rough pasture land reverting back to secondary growth.

The Mohakatino Farm Settlement block was taken over by the Crown in 1959 for economic and national interest reasons (the land was considered too good to allow to revert back to secondary growth). This property stretches between the Mokau and Mohakatino Rivers from the coast inland and is used for sheep and cattle farming. The coastal area is more intensively grazed than inland areas. Proposals are to settle two units of this block.

An old station known as Mangatoi is part of a 41445 ha block. Much of the block is now in rough pasture and considerable scrub forest. The area is still grazed by cattle, sheep, and feral goats.

Natural Conservation Areas

These areas are managed to ensure that the natural landscape is protected against depletion or destruction.

The Department of Lands and Survey administers separate areas of native bush on both the northern and southern banks of the Mokau River as the Mokau River Scenic Reserve.

Crown Land reserved from sale are protected areas administered under Section 58, Land Act 1948 and give public access along the river in places.

Parts of Mahoenui and Panirau State Forests are other places within the study area where the flora and fauna are fully protected.

Under the Waitomo County District Scheme some pockets of land within the study area are recommended as potential conservation areas to retain the bush cover for soil and water conservation and river control purposes.

Other Uses

Mokau township is the only notably populated settlement in the study area and is largely a summer resort and service centre containing a Post Office, shop, school, police station, motor camp, garage and Ministry of Works and Development Depot. The township has approximately 181 occupied dwellings and a further 100 baches. Mokau township also services State Highway 3 traffic and the local district community.

Recreational pursuits associated with the coastal environment, the township, the river and its associated bushlands are ever increasing. Hunting, tramping, canoeing, jetboating, off road vehicle driving, fishing, whitebaiting and boating are all on the increase. These and other recreational pursuits associated with the Mokau will be discussed in the Recreation Section of this report. At present the natural largely undeveloped state of the area is a valued attraction.

Commercial floundering is carried out by two operators living at Mokau.

Coal mining and quarrying have taken place on a relatively large scale in the past. Investigations have taken place more recently in connection with the large coal reserves beneath the northern Mokau region, and feasibility studies for possible coal mining are continuing.

Pipeline easements exist over land just upstream of the Mokau township running north and south.

Conclusions

Within the study area indigenous forest cover (protection and minor production) and extensive hill country pastoral farming are the main land uses.

There is unlikely to be any major land use change in the study area in the near future. Development of the Mohakatino Farm Settlement administered by the Department of Lands and Survey could provide some change in use dependent on development decisions to be made.

A possible future land use change of great significance would be the development of the Mokau Coal Resources and any associated developments making use of this coal, such as thermal power generation. Such developments would have a major impact on farming, recreation, conservation and other values in the study area and could affect recreational users enjoyment of both the scenic reserves and the river.

REFERENCE INFORMATION

1. Clifton County District Scheme Review No 1
Operative 20 December, 1984.

2. National Water and Soil Conservation Organisation, 1979
New Zealand Land Resource Inventory Worksheets (N91:100)
Ministry of Works and Development, Water and Soil Division.

3. Waitomo District Council District Planning Scheme
May 1983.

4. NZMS 1 Topographic Series N91, 100
Department of Lands and Survey.

RECREATION

A very broad range of land and water resources provides facilities for a variety of active swimming, fishing, walking, hunting, boating and vehicle related (motorcycles, 4WD) outdoor recreational activities in the study area. The availability of holiday and camping facilities at and near Mokau also enhance the area's attractiveness which is highly valued for both its present and potential future usage.

Fishing (surfcasting, line, floundering, netting and whitebaiting) and hunting (goat, possum, pig, duck, quail and pheasant) are the two major recreational pursuits, while canoeing is rapidly gaining in popularity. Other less significant pursuits include swimming, recreational boating, trail bike riding and off road vehicle driving, scout and club camps and bush walking.

Fishing

Owing largely to the tidal nature of the River, and also to the study area's hydrological characteristics, a variety of fishing activities are carried out on the beach front near Mokau township and further up the Mokau River.

The Mokau River has the reputation of being the most productive whitebaiting river in Taranaki (Taranaki Catchment Commission, 1981) and is extensively fished during the whitebaiting season - that is, from the months August to November. About 300 people may be involved at the peak of the season, whitebaiting up to 35km upstream. According to local fishermen, the number of people fishing has doubled in the last 10 years with many people taking their annual holidays during the whitebaiting season.

Of less significance are trout fishing and floundering carried out in the upstream freshwater and rivermouth/estuary sections of the River respectively.

Depending on the tides and weather up to 40 people may be seen daily, surfcasting along the beachfront near Mokau township. In comparison with whitebaiting these numbers may be relatively small but surfcasting is not a seasonally restricted activity. Fishermen claim that catches of snapper and kahawai have declined over recent years to the extent that it is no longer worth their while to travel to Mokau from New Plymouth for one day's fishing. This decline is reflected in fewer people coming to the area and, as is to be expected, has been attributed to commercial trawlers working inshore, close to the beach. Some fishermen would like to see a 'twelve-mile' limit imposed similar to that at Waihi on the Coromandel Peninsula.

One kilometre south of the rivermouth is the Mohakatino Reef which is very popular for fishing and mussel gathering. A decline in the size and quality of mussels over recent years is being reversed due to fishing regulations enforced by fisheries inspectors.

The recreational fishing resources of the Mokau River, rivermouth/estuary, and beachfront are being utilised to their fullest extent - some may say over utilised. There exists, therefore, (remembering the limited empirical base of this survey) no future potential for increased usage by recreational fishermen without inevitable adverse consequences.

Hunting

It is impossible to say how many people hunt in the scrub and bush covered blocks of private and reserve land alongside the Mokau River and on the River itself. All New Plymouth hunting organisations acknowledge their irregular presence in the region but make two other important comments. First, their own memberships are but a small part of all of the people involved in shooting and trapping, and second, and more importantly, their usage of the study area, while presently low to medium with regard to other hunting areas, is gradually increasing. They all regard the potential for controlled access and future usage very highly.

Game consists of goats, possums and occasional pigs in the back-country bush and scrub while rabbits and hares are sometimes bagged on the open country along the coastal fringe. Ducks and other waterfowl are shot from May to July, on and alongside the River to beyond Mangatoi Station.

Caving

Outside the study area, but related to the River where the underlying rocks are Te Kuiti Limestones, the action of percolating, slightly acidic groundwaters have created a variety of caves and sinkholes. These are regularly explored by cavers from New Plymouth, Manawatu, Hamilton and Auckland. There are also caves on the left bank of the Mangaawakino Stream which were once regularly visited but usage of these caves today is unknown.

Access to these caves is generally good but recent land clearing and farming operations are making it difficult for cavers to find them as local landmarks are cut down or removed.

Canoeing

Canoeing and rafting in the narrow and tortuous upper reaches of the River from Wairere Power Station to Mahoenui Hill is rated very highly by Taranaki Canoeists by virtue of the River's difficulty when compared with other local more regularly used rivers. Canoeing generally takes place after a period of high rainfall when water flows are high and power station discharges are minimal.

More sedentary type canoeing from Mangamahoe Road downstream to the Awakau boat ramp is becoming increasingly popular. While not as 'adventuresome' as the upstream sections of the River, such as the Totoro Gorge, these stretches are largely lined by native bush, steep bluffs and historic sites which make them very popular.

In addition to recreational canoeists, the Department of Lands and Survey organises and administers a trip down the lower section of the River as part of its Summer Nature Programme. Commercial venture trips have also recently commenced.

Canoeists, like hunters, do not use the River as intensively as those who fish the River, but they regard it as a valuable potential resource and are very concerned about future developments which might have an impact on the River's recreational values.

Motor Vehicles

The study area is rarely used for recreational purposes by riding and driving enthusiasts, aside from some local riding of motorcycles and driving of 4 wheel drive vehicles on privately owned land.

The most regular motor vehicle recreational activity in the study area is organised by the Taranaki Motorcycle Club by way of annual trail rides and a motorcross fun weekend held at Mangatoi Station which caters for approximately 100 people. Moto-cross events are held on local farms and beach races are held on the beach between Mokau and Awakino.

Both motorcycle and 4WD organisations regard the study area as significant in terms of potential recreational uses and have plans to use the area more regularly.

Other

Sightseeing trips on the Mokau River are usually carried out in conjunction with other activities previously described in this section.

Lacking a landscape section in this report, a brief note about the landscape and scenic values of the Mokau River is warranted here. Many different factors contribute towards the scenic qualities of the River (e.g. vegetation, banks, riverbed, landscape, wilderness feeling, water quality, water movement and other features). Egarr, et al, 1979, gave the Mokau River south of Wairere Falls to the coast, a scenic value rating of 'impressive' through a progressive scale of dull, uninspiring, moderate, picturesque, impressive, exceptional. This rating applied for both the Totoro Gorge and Lower River sections of the River. The 'impressive' value given to the River comes just below the value 'exceptional' which only six North Island Rivers received in 1979. since then, two of these rivers have been significantly altered through diversion.

In a report prepared for the Mines Division, Ministry of Energy (May 1984), it has been noted that some correspondence has passed between the Waikato Valley Authority, Waitomo District Council and the 'Save the Rivers' organisation relating to the seeking of a local conservation order for the Mokau River, under the Water and Soil Conservation Amendment Act 1981. The report recommended that this situation be monitored and any further moves to apply these legislative procedures to the Mokau River be taken into account during more planning and the assessment of alternative sources of water supply and waste disposal.

Swimming, walking, sunbathing and surfing are also carried out by both day trippers and people staying in Mokau Township.

Sections of Scenic Reserve and other native bush in the mid reaches of the River are also used by scouts and other clubs for camping and bush craft courses.

Any changes to the water quality and/or quantity of the Mokau River may have significant impacts on these activities which are particularly popular in Mokau Township and the rivermouth. Given that the Motor Camp owner finds the whitebaiting season to be his busiest time of year and assuming that the number of long term holiday makers at Mokau reflect the number of day trippers, there exists potential for increased leisure-type recreation over the traditional 'summer holidays'.

Conclusion

A combination of narrow, rushing white-water and placid, slow moving river reaches, with a tidal influence that extends far upstream, a surf beach frontage and large areas of native bush with goats and pigs, and a colourful local history make the study area suitable for a variety of recreational activities. At present such pursuits range from intensive fishing of all types to the occasional motor vehicle activity.

Appreciation of the Scenic Reserve areas along the riverbanks appears to be derived largely from aesthetic qualities - not through active walking and exploration. Access is largely restricted to boats because of the disconnected nature of the Reserves, and lack of public land access.

Increased use of the River by canoeists and surrounding land by hunters are two activities which the study area could easily cope with. Activities by the Department of Lands and Survey such as the possible creation of the Mokau-Mohakatino Walkway and a Farm Park at Mohakatino; the construction of basic campsites along the River at Panirau Island and the Old Lime Kiln site; small, clearly marked side tracks to historic sites and lookouts; and additions to the scenic reserves on both sides of the River, would all greatly enhance the study area's recreational suitability and usage. Apart from fishing complaints (related to the number of people during the whitebaiting season and trawling close inshore) there have been no complaints about the numbers of people using the area for recreational purposes. Increased usage, in general, is therefore not envisaged to put too much pressure on the region. A water conservation order for the Mokau River, if applied even to only parts of the River would ensure that this important water resource could be adequately protected for recreational use in the years to come.

REFERENCE INFORMATION

1. Department of Lands and Survey (New Plymouth), December 1982:
The Tongaporutu-Awakino Coastline - A Recreational Survey 1981-82

2. Egarr, G.D. and J.H., 1978:
Taranaki Canoeists Guide; The New Zealand Canoeing Association (Inc)

3. Egarr, G.D. and J.H., and MacKay, J. 1979:
64 New Zealand Rivers - A Scenic Evaluation; The New Zealand Canoeing Association (Inc)

4. Taranaki Catchment Commission, November 1981:
The Recreational Whitebait Fishery in Taranaki

POTENTIAL DEVELOPMENTS

Introduction

This section is devoted to those developments which have been or are still the subject of investigative study by Government and other organisations. For ease of explanation, they have been categorised into the following topics:

- Farming and Forestry
- Coal Mining
- Thermal Power Generation
- Road Access
- Coal Transport
- Hydro Electric Power Generation

Some of these developments (e.g. farming and opencast mining) are directly in conflict with each other whilst activities such as mining and thermal power stations are complementary.

There are also other potential developments in the study, such as:

- Recreation
- Dairying, Horticulture and other "new" (to the area) types of farming
- Protection of Natural and Historic Features by Reservation, Water Conservation Orders, etc

These are not covered because they have not been the subject of any detailed investigation. However, they remain possibilities which should not be ignored.

Farming and Forestry

The following comments relating to farming and forestry in the study area are largely based on a Land Use Capability Survey of the Mangapapa B2 Block. The survey was carried out in 1977 by the Waikato Valley Authority for the New Zealand Forest Service who were considering the Block for afforestation should it prove economically feasible, given the cost of providing access and developing the Block to its upper limit. From the survey, Management Options for Forestry and Farming were investigated with the over-riding constraints to development (significant Coal Reserves and the Scenic Reserves along the Mokau River) taken into account.

The topography of the Mangaawakino Block in the north of the study area has more extensive plateaux (on Upper Mokau Sandstone surface) than the Mangapapa B2 Block in the south which has more steeper, higher country (of Mohakatino Sandstone). Despite these differences it will be assumed that comments made by the Waikato Valley Authority about farming and forestry in the Mangapapa B2 Block Study are equally valid for the Mangaawakino Block and much of the rest of the north bank of the Mokau River.

On the south left bank of the Mokau River, the topography is, however, even steeper and most of this land is only suitable for water and soil protection purposes or extremely controlled logging.

Agriculture

The Mangapapa B2 Block comprises Class III to VIII land (see Figure 7) with the major constraint to development being potential erosion. Wetness through flooding, and poor drainage on low, flat terraces along the Mokau and other stream valleys is another, but less significant, constraint.

Areas of rolling Class III(e) to Class IV(e) land and some higher terrace-like flats on the Class VI(e) hill country could be developed into an effective extensive grassland unit. The Class III(e) and IV(e) land is capable of cropping and has a stock carrying capacity potential in the order of 15 stock units per hectare under average efficient management. The steeper hill country could potentially carry 10-11 stock units per hectare.

Class VII(e) and VIII(e) land would not be available for development for agriculture or forestry because of the thin soils present and because the underlying strata becomes highly erodible when exposed to water and wetting and drying actions. Vegetation clearance would also lead to serious slippage or sheet erosion through the removal of the binding ability of plant roots and the presence of water which would otherwise have been lost by evapotranspiration.

The Waikato Valley Authority calculated that of the total area of Mangapapa B2 Block of 4666 hectares, 998 hectares was suitable for intensive use, 1747 hectares was suitable for extensive grazing, and 1921 hectares should be left undisturbed as protection areas. The property could probably carry about 30,000 stock units at full development.

Afforestation

The Waikato Valley Authority survey, in conjunction with an internal New Zealand Forest Service study, identified three options for potential afforestation development on the Mangapapa B2 Block. First, complete afforestation of all those areas that are suitable (i.e. Class III(e) to Class VI(e) and Class VII(e) land). This would involve 2745 hectares. Second, a farm-forestry operation on the Class III(e) and Class VI(e) land (998 hectares) and forestry on the remaining suitable land (1747 hectares). The third option is to separately farm the Class III(e) and Class IV(e) land (998 hectares) and afforest the suitable hill country (1747 hectares).

Forest establishment could be accompanied on some areas of Class VII(e) land only if caution was exercised when clearing and extracting, and constructing roads.

Coal Mining

The Mines Division of the Ministry of Energy is presently carrying out a New Zealand-wide coal resoruces survey of all the main coal resources. As well as evaluating deposits for specific coal needs, the programme is evaluating all of New Zealand's coal resources in order to facilitate long-term planning, efficient resource management and suitable use of an indigenous energy resource.

The major exploration effort has been in the Waikato, Taranaki, Eastern Southland, Central Otago and Greymouth coal regions. Two exploration programmes are underway in the Taranaki coal region - the Mokau and Kawhia Coalfields.

The Waitewhena Coalfield is also in Taranaki (Figure 10). This Coalfield was geologically surveyed in 1978-79 as a basis for more detailed prospecting work and was estimated to contain 114 million tonnes of 'inferred' coal. However, despite their geological similarities, Mines Division are 'more happy' with development prospects of the Mokau Coalfield. Fletcher Challenge Ltd presently hold a prospecting licence over the Waitewhena Coalfield. Their early plans to produce liquid and solid fuels by a pyrolysis process appear to have been shelved in favour of the examination of the coalfield for its potential to supply the needs of a thermal power station. The coalfield touches on the Mokau River catchment, but main access routes and likely exploitation areas are in the Waitewhena Valley which is outside the catchment and the study area. As a result the Waitewhena Coalfield is not considered further in this study.

The Mokau Coalfield has been the subject of a number of geological reports, and an interim mining feasibility assessment was prepared in December 1982. The work of all the reports has recently been brought together in an April 1984 report by Mines Division entitled Mokau Coalfield Energy Development.

The only market identified for Mokau coal is thermal power generation. Electricity forecasters consider that, assuming a middle-range trend in electricity demand growth, a new 1000 MW power station will be needed in the North Island by 1995. Additional generation capacity would be needed if demand increased at a higher rate. The Waikato coalfield is the first choice to supply this new power station, and the Mokau coalfield is presently regarded as a fallback position should significant problems occur with the Waikato developments, or should demand follow a high level growth curve. Should either of these possibilities not eventuate, the Mokau Coalfield is not expected to be developed for a further 20 years.

To be able to meet the 1995 deadline, a decision on the site of the power station, and thus which coalfield is to be used, would need to be made by 1987. Any development on the coalfield would not need to commence before 1989, as the lead-in time for development of the power station is longer than for the mines.

A 1000 MW power station requires 1.8 million tonnes per year of coal with the possible requirement for an extra 0.5 million tonnes in a dry year with a higher generation factor. The latest estimate of the amount of coal in the Mokau coalfield is 99 million tonnes, of which some 73.6 million tonnes would be recoverable by both underground and opencast methods, and on this basis the Mokau coalfield is considered to be of a suitable size for such a development.

The interim mining feasibility assessment estimated that a single opencast mine working on the terrace lands of Mangatoi Station could provide about half of the annual coal requirements. The other half of the coalfield's production would come from three underground workings, with entrances located:

(a) in the valley of the Mangangarongaro Stream;
(b) in the valley of the Mangaawakino Stream;
(c) close to the present Valley Collieries mine overlooking the Awakino Valley.

Later on, additional underground entries would be developed on the eastern side of the opencast pits, where the coal seams continue under the bluffs of Upper Mokau Sandstone.

Total manpower at full production would be 763.

The above scenario was based on the information at hand as at April 1984. Further investigations could lead to some modifications.

The interim mining feasibility assessment comments on a number of implications of the proposed development, and these can be expanded upon in the light of the natural resource statements earlier in this study.

The coalfield area is not easy country to work in. Rainfall is high, and potential erosion on the steep slopes is rated severe to extreme. The coalfield adjoins (and to a certain degree underlies) scenic reserves, and drainage is into a river of high scenic and recreational value.

With the exception of roading access, the need for earthworks on steep slopes appears to be limited. Most earthmoving for opencast pits will be on gently sloping or near flat land, and so will have little impact on erosion potential. However, the sides of the pits and placing of material in the worked-out parts of pits could have erosion consequences. A further erosion possibility is the spoil pile created by the excavation of the first opencast pit (subsequent pits when created will be used for infilling of earlier pits). The interim mining feasibility assessment suggests that the spoil be placed in a gully on Mangatoi Station which drains directly into the Mokau River. Slumping or slipping of the spoil would have to be guarded against, as any pollution or obstruction of the River could have significant downstream consequences.

The feasibility assessment has excluded from its calculations of recoverable coal any coal beneath scenic reserves or within 200 metres of the Mokau River. This seems to be likely to avoid any major visual impact on river users, though this factor, and noise factors, have not yet been fully investigated. However, it is known that Mines Division are interested in possible future extraction of coal lying beneath scenic reserves.

Any drainage from the coalfield developments will eventually find its way into the Mokau River. Runoff could be affected either unintentionally (e.g. faster rate of runoff, more suspended sediments) or deliberately (e.g. damming of tributaries for water supply, creation of ponding areas at the lower end of opencast pits). Chemical composition could be affected by the passage of water through pyrite-containing mudstone overburden, or by fuel and oil pollutants. Any changes in the flow of the river would have downstream consequences and could also affect the enjoyment of river users. The drainage implications of the coalfield may bethe hardest to predict and the hardest to overcome.

Thermal Power Generation

The Mokau coalfield could supply a 1000 MW thermal power station reticulating to the northern half of the North Island. The proposal at present is to construct 4 x 250 MW units, similar to the power station at Huntly. This would allow some flexibility in construction timing, allowing say the first 500 MW to come on stream earlier than the second 500 MW, which may not be immediately required in 1995.

No optimum locations have yet been identified for the proposed thermal power station. Generally power station location proceeds through at least three stages before a final location decision is made. Stage 1, involves a consideration of four major economic contraints - coal supply, the cost of coal transport, the cost of cooling water supply, and the cost of workforce commuting and accommodation - to define Locality Corridors within which economically acceptable sites are found. Stage 2 involves an estimation of constraints such as geomechanics, social and environmental impacts, and planning considerations to define Preferred Localities within the corridors. Preferred Site Areas are chosen in Stage 3 on the basis of detailed geomechanical studies. From the small number of Preferred site areas the final site location decision is made.

Present investigations for the proposed Mokau power station are still at Stage 1 - clearly far from the point of being able to make a final decision. In comparison, the Second Waikato Power Station investigations have passed Stage 3, and the final decision will be made between one of three Preferred Sites.

For the purpose of the Infrastructure Report (Ministry of Works and Development, 1983) representative power station and township locations were chosen for preliminary costing purposes and to assist in the recognition of the problems which would result from development in the general areas considered. The representative locations were: Mokau/Mahoenui; New Plymouth; Otorohanga, and for the purpose of cost comparison only, Lower Waikato. No 'specific sites' have yet been identified in the latter three representative locations but sites have been examined in the most general terms for the Mokau/Mahoenui location. The Mokau/Mahoenui location has advantages in that limestone (for sulphur extraction) is available locally in the Awakino Basin and coal transport distances would be short but it has disadvantages in terms of lack of existing infrastructure, and long transmission distances to electricity markets.

Two sites on the Mokau River have been suggested. The first is a very constricted site (60 hectares) with little scope for enlargement close to Mokau township on the north bank of the Mokau River. The second is a constrained site (80 hectares) on the south bank of the Mokau River further up the valley near the Awakau Road crossing. The third site is at Mahoenui on the south bank of the Awakino River between State Highway 3 and Papakauri Road. An adequate area is available but, unlike the other two sites, the foundation conditions could be difficult.

None of these sites has been examined in any greater detail.

The main physical impacts of a thermal power station result from the station's land requirements (area, access to cooling water and ash disposal) and the way the station affects the natural environment (cooling water, air quality, direct infringement, visual and noise impacts).

Based on experience in the Waikato, up to 100 hectares are needed for a power station's main structures (powerhouse and associated buildings, switchyard, cooling towers, and coal stockpile). But until ash disposal and cooling water options are decided upon the exact land area required by the station cannot be identified.

To condense steam and carry waste heat away from the station's turbine exhausts, a large amount of water is required. Different cooling options are: cooling towers, ponds and spray canals, and open cycle cooling using river or sea-water. A combined system is also possible. Given that sites in the study area appear to be very constrained and that land requirements of a cooling pond system can be as much as 400 hectares, it is unlikely that this type of system will be adopted. In addition, with the exception of a sea-water source, neither the Mokau nor the Awakino River have sufficient quantities at times of low flow to meet open cycle cooling water station demands of about 38 cumecs. It is therefore not inconceivable that the cooling water demands of the proposed station would be met by a cooling tower system. Such a system would draw off approximately 0.8 cumecs of water of which some two-thirds would be lost by evaporation and one-third returned to the river. The greatest net loss of water would therefore be in the order of 0.53 cumecs - that is, about one-tenth of the summer flow recently recorded at the Paraheka Valley Road swingbridge (GR N91 428427). The temperatures of any station cooling water discharged into the River and consequent effects on river ecology are unknown.

In addition to gases, burning coal also produces solid wastes - mostly a type of ash, called 'fly ash', and other materials called 'bottom grits'. The proposed station would generate about 100,000 tonnes of fly ash a year. The ash can be disposed of in several ways - commercial use (as a cement additive), filling of old mine workings deep landfill (valley infilling) or shallow landfill. Over the lifetime of the station more than 100 hectares could be required to hold all the ash produced if a shallow landfill method is used.

Air pollution from sulphur and ash emissions is a major environmental concern especially as, by New Zealand standards the amount of sulphur (2.36%) and ash (7.5%) in Mokau coal is high. Sulphur and ash can be removed from gas flues in a number of ways. One method involves 'scrubbing' the gas flues using limestone to remove SO_2 which, unless removed, may react with moisture in the atmosphere to form 'acid rain'. At a coal:limestone ratio of approximately 50:1 scrubbing gas flues would require 40,000 tonnes of limestone each year. This would probably involve the establishment of another mining operation based on Te Kuiti Limestone with similar, but smaller scaled impacts to those described for the Mokau Coalfield developments. Such a mine would be approximately one-half the size of New Zealand Limestone Products Ltd (often called Dibble Bros) mine, along Bercos Road at Te Kuiti.

Any location of a power station could bring it into conflict with some important resources (for example, a mineral reserve or area of wildlife value), significant social issues (for example, land in Maori tenure or historical sites) or planning policy (for example, the protection of good agricultural land). However, there do not appear to be any significant resource conflicts or social issues with the selected Mokau River sites. Both areas are however presently used for extensive grazing, but have a high production pasture potential, and thus potential conflict with planning policy.

Because a power station is a big structure it must to some extent dominate the landscape around it. The proposed station will probably look very much like the one at Huntly, with the addition of two 100 metre cooling towers. The actual site, the layout adopted and suitable landscaping can, however, do a lot to integrate the station with the surrounding countryside.

In addition to the physical consequences of a power station there are the social implications. Construction of the power station would require a workforce of some 2000, while operations would require some 500 staff. In addition to these figures there would be the mining workforce of 763. An influx into the Mokau-Awakino-Mahoenui area of a workforce of this magnitude, together with dependents and people to service this population increase, would suggest a major social upheaval for the area. In examining this aspect in its Infrastructure Report in 1983, the Ministry of Works and Development considered that a new town would be required. The past experience of the district with the gas pipeline developments, which were much smaller in scale and shorter in time than what could eventuate, was mildly traumatic for the local population and economy. A coalfield and power station development would be much more so and while the implications would be of a both postive and negative nature substantial changes of any type would be a cause for feelings of stress.

Road Access

Access into the hill country in the northernmost extent of the study area has always been a source of concern. The study area enjoyed advantages in the past of having water access as an alternative to roading, and a coalfield to stimulate economic activity, but these are no longer applicable today. Water access to serve farming, forestry or mining is unlikely to be revived, although it has potential for tourism and recreation. Thus future development of farming, forestry and mining is dependent on the upgrading of road access.

Discussion of roading access is a significant feature of both the Waikato Valley Authority's survey of the Mangapapa B2 Block, and the Ministry of Energy's interim mining feasibility assessment. The Authority's survey examined two routes into Mangatoi Station being along the river, and along ridge tops, while the mining assessment considered these two, and a third valley sidling route.

The river route involves upgrading an unmetalled poorly graded track along the north bank from the Mokau Valley Road to near Awakau Bridge, a distance of 12 kilometres. In part this route runs through scenic reserves. Widening will require a number of high faces cut in the valley side, but these cuts are likely to be fairly stable. Bridges over tributary streams will be required, as the fill around culverts could be undercut by tidal fluctuations in the river. The route will be liable to flooding during high river flows (the present track is built on alluvium and is sometimes washed out) unless constructed higher up the valley side at greater cost and with greater impact on the reserves and the valley landscape. A Forest Service estimate in 1977 of the costs of a river road plus internal access on Mangatoi Station, for logging purposes only (i.e. not to public highway standard), was $700,000. The mining assessment similarly drew attention to the flooding and environmental impact problems associated with this route, and concluded that it could not be recommended.

A ridge top route has more attraction, but is not without problems of its own. The main one relates to stability. As the ridges are composed of Mohakatino Series rocks, with their higher clay content, there is a high potential for erosion where the weathered rock is wet, and the clay content causes swelling. The Waikato Valley Authority considers it to be a very unstable material prone to slipping, gullying and flow movements on fill batters, and rilling and gullying on the road surface.

Thus, by contrast with the river route, construction costs would probably be cheaper, but maintenance costs would be higher. The mining assessment also refers to the possibility of high winds and misty conditions, and the provision for steep winding roads from the ridge top down to coal extraction sites. The ridge route considered by the Mining assessment is from Awakau Bridge along the south eastern boundary of the Mangaawakino catchment.

The final choice is a route within the Mangaawakino Valley, which then climbs up and over the south eastern catchment boundary ridge and down to the coal extraction sites. This will require a cut into the valley side and crossing of tributaries similar to that for the river route, but without the likelihood of flooding problems. As with the ridge top route, the road would be constructed through indigenous forest and scrub.

Apart from the river route, where only one choice of route is available, it is not possible to be more definitive about the location of future roads. With the mining developments especially, the route is very much dependent on the location of the power station and the workforce accommodation. Thus a ridge top route headed northwards towards Mahoenui is still a possibility.

Coal Transport

While the Ministry of Works and Development Infrastructure Report has dealt only with aspects of the costs for township infrastructure and construction transportation and the Ministry of Energy Mining Assessment only with the costs and means of developing the Coalfield and delivering coal to the mine gate, the third component of the proposed Mokau Coalfield - Power Station developments, the coal transportation method has not, as yet, been decided upon, let alone described. This is because the method chosen will depend on where the coal has to be moved to. Road, rail, slurry pipeline, conveyor or similar systems are all potential methods of transportation. Because coal volumes to be transported are so large (two million tons per year) and because of the difficult nature of the Mokau River, transportation by barge is unlikely to occur.

To provide two million tons of coal per year to the power station requires an output of 5500 tonnes of coal per day working on a 365 day year basis. Given a truck-transport method where trucks carry 60 tonnes of coal per load, this means 90 return trips would be carried out each day. For 40 kilometre round trips this will mean a total mileage of 3660 kilometres per day. For this reason coal transport by trucks may not be chosen. Given the quantities of coal involved, the lack of rail transportation routes to power station sites at Mokau and Mahoenui and the present usage of a conveyor to the Huntly power station from the servicing coal mines, a conveyor system seems the most likely form of coal transport (providing the terrain is not too obstructive). Slurry pipelines and aerial ropeways are alternative similar types of transport which may prove to be acceptable.

At this stage it is not clear how much flexibility these methods of coal transport offer in their choice of route. Each would presumably require a maintenance and inspection track alongside, so that their impact may be similar to that of the access roading. A slurry pipeline would in addition involve a water supply and dewatering facilities.

Hydro Electric Power Generation

Upstream of the study area there are two small hydro projects operated by the Waitomo Electric Power Board.

The Mokau River (Wairere Falls) generation scheme is situated approximately eight kilometres downstream from the township of Pio Pio. Opened in 1925 this scheme has a maximum generation capacity of 4.3 MW. The Mokauiti River generation scheme is approxiamtely two kilometres downstream from Aria township. This pipeline scheme was opened in 1935 and diverts water from the river by means of a weir and along an eight kilometre long pipeline to the powerhouse further downstream which has a maximum generation capacity of 1.8 MW. Both these schemes cause very little environmental impact as they work on the 'run-of-the-river' principle, and do not have large reservoirs associated with them.

Potential hydro-electric sites suitable for development by a Local Authority on the Mokau River have been examined in a report of local hydro potential compiled in 1982. Several mid and lower reach sites in the Mokau River Catchment have been identified as having sufficiently large flows to warrant consideration of 'conventional' type hydro power schemes, comprising dam and adjacent power house connected by short penstocks.

There are two fundamental requirements for potential development of a hydro-electric power generating station. First, an adequate and reliably defined flow of water and second, topography which favours the development of generating head by inexpensive and simple dam and conduit. Other factors which will have significant effects upon the viability of a scheme include; the topographic water storage capacity; inclusion of nearby streams; the value of the land to be inundated; requirements of other competing water uses; proximity of the site to centres of electricity demand and existing transmission lines; and other environmental factors.

The more technically and economically favourable schemes on the Mokau River or its tributaries described in the Assessment report are summarised below.

Lower Mokau River - A substantial mean flow in the lower reaches of the Mokau River combined with a number of alternative dam sites on loops in the River, afford opportunities for the development of a sizeable conventional type hydro scheme. Owing to the very flat gradient of the Mokau River, rising only 31 metres in the first 36 kilometres from its mouth, only one scheme could be developed.

Three sites were identified as showing comparable economics and best physical characteristics. These are:

- Seven kilometres upstream from the river mouth, near the Lawsoniana plantation 29 MW capacity; 45 metre high earth/rockfill dam creating a 65 kilometre long lake.

- Seven and a half kilometres upstream of Mokau Valley Road bridge at Awakau. Not studied in detail.

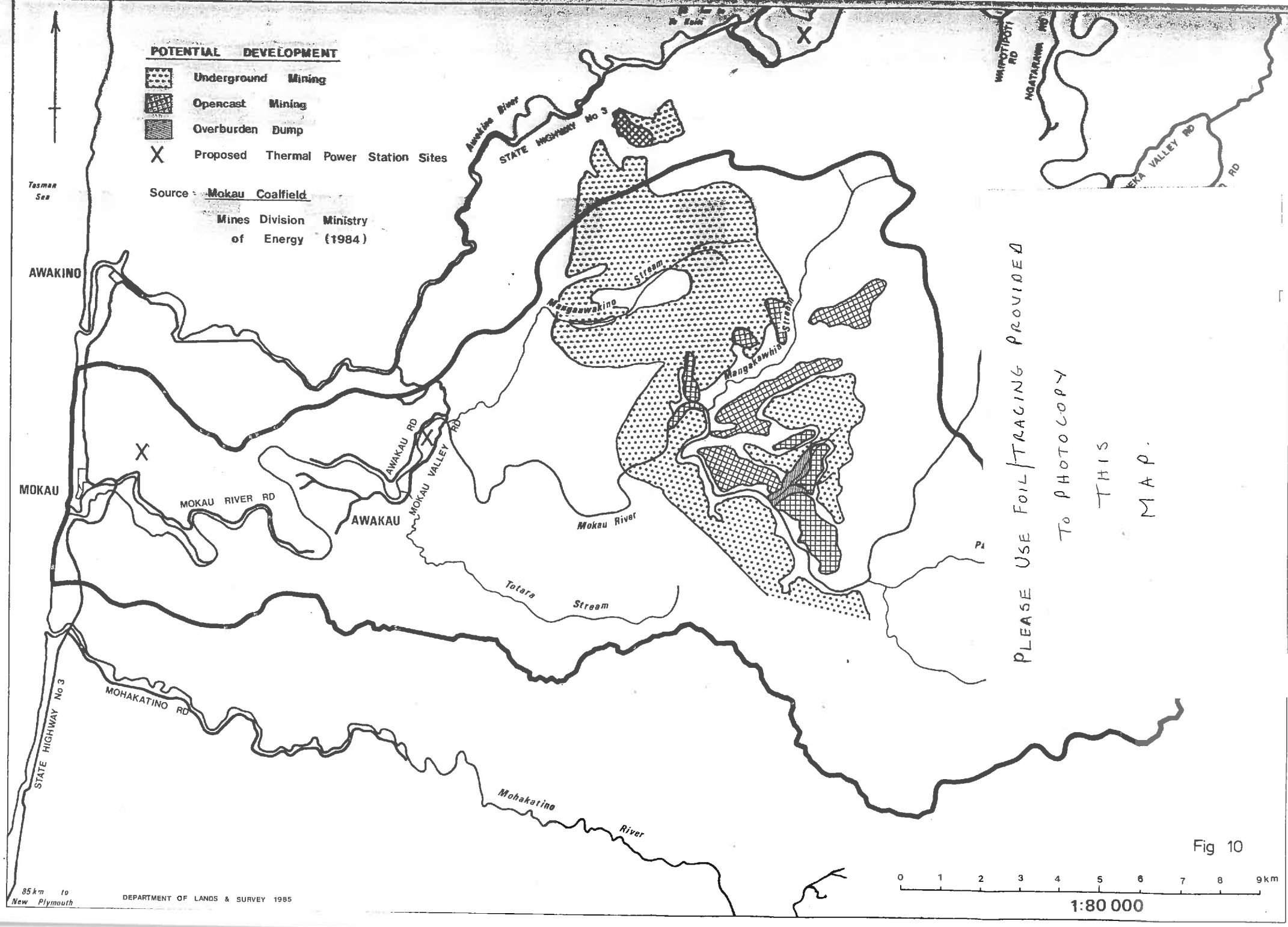
- One kilometre upstream from Parahaka Stream confluence; 20 MW capacity; 40 metre high earth/rockfill dam creating a 20 kilometre long lake.

The report emphasises that these proposals are highly speculative in both the technical sense and in the costs attached. The absence of flow records for the river, the high flows over the spillway during floods, and the uncertainty about the availability of suitable fill material and about constructing moderately high dams in soft Tertiary rock are all complicating factors. In addition there are no nearby users of the electricity to be generated, and a transmission line would be lengthy and costly.

Other hydro-electric proposals are for small run-of-the-river schemes upstream of the study area, which would not have any significant impact on river flows in the study area. The three schemes outlined in the report are located:

- on the Mokau River downstream of Wairere Falls and Wairere power station;
- on the Mokau River at Taraunui Falls, nine kilometres south of Te Kuiti;
- on the Mapiu Stream at Omaru Falls.

The local electricity authority (Waitomo Electric Power Board) is not actively pursuing or seeking to establish other power stations on the Mokau River or its tributaries. Aside from the lack of Government finance available to establish such schemes, the sites described above are not being investigated as they are all relatively expensive (both in actual terms and cost/kw generated), and there is no sizeable local demand for electricity in the region.



PLEASE USE FOIL/TRACING PROVIDED TO PHOTOCOPY THIS MAP.

Fig 10

REFERENCE INFORMATION

1. Longworth and McKenzie Pty Ltd:
December 1982:
New Zealand Coal Resources Survey - Interim Mining Feasibility Assessment - Mokau Coalfield

2. Ministry of Energy (Mines Division):
November 1983:
Mokau Coalfield Energy Development

3. Murray-North Partners Limited:
1983:
Waikato Energy Developments - Infrastructure and Social Impact Study

4. Ministry of Works and Development:
August 1983:
Mokau Coalfield and Power Station Development - Township Infrastructure and Construction Transport - Preliminary Cost Assessment

5. Ministry of Works and Development:
February 1982:
North Taranaki Coal Based Projects - Initial Planning Appraisal

6. Phelps, D.J. and Co Ltd:
August 1982:
New Zealand Coal Resources Survey - Mokau Coalfield - Interim Report of Exploration

7. Tonkin and Taylor Ltd:
January 1982:
Assessment of Local Hydro Potential Waikato Valley Authority Area

8. Waikato Valley Authority:
1977:
Mangapapa B2 Block